1987

Administering a Promotional Examination in the Fire Department of a Large Midwestern City

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ADMINISTERING A PROMOTIONAL EXAMINATION IN THE FIRE DEPARTMENT OF A LARGE MIDWESTERN CITY

by

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A Thesis Submitted to the Faculty of the Graduate School of Loyola University of Chicago in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

April

1987

ACKNOWLEDGMENTS

I would like to thank the members of my committee for their help, guidance, and encouragement in the preparation of the thesis, and for their patience afterwards. Dr. Scott Tindale and Dr. Fred Bryant provided useful suggestions at the times they were needed most.

I would also like to thank several members of the Department of Personnel for their help. Sheldon Hurovitz provided helpful information regarding the test administration and the prior test. Larry Czarkowski gave useful information and reviews of early drafts. John Molcan provided assistance in the computer analysis of the results. I gratefully acknowledge all of their assistance.

VITA

The author, Joseph William Giganti, is the son of William Anthony Giganti and Mary (Gaughan) Giganti. He was born October 7, 1956, in Buffalo, New York.

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CHAPTER I

INTRODUCTION

This paper will deal with the development and implementation of a promotional examination to be used in the Fire Department of a large city. First, the background of employee selection as it relates to the courts will briefly be discussed. Next the background of this particular test will be discussed, followed by the specifics of its development and implementation. A discussion of the results will follow, along with a discussion of the implications. Finally, the summary will discuss aspects of this test which could be changed for future administrations.

In the past several decades, there has been a growing practice on the part of many governmental agencies as well as private industries of using quantifiable measures of personnel selection at both the entry and promotional levels, instead of the old methods of relation and seniority. As these methods were more widely used, the courts began to play a major role. Many selection instruments were challenged. The courts decided on the validity of the selection procedures. However, the standards for deciding the validity of a procedure were not clear. As a result, the decisions handed down in these cases were often contradictory. An article by Thompson and Thompson (1982) reviews these cases and the contradictions. Clearly, there was a need to standardize

the criteria used in deciding a procedure's validity. As a result of these cases, and in order to safeguard the proper use of these selection methods, a set of guidelines were drawn up by four agencies. These agencies were the U.S. Equal Employment Opportunity Commission, the U.S. Civil Service Commission, the U.S. Department of Labor, and the U.S. Department of Justice and in 1978 they published the Uniform Guidelines on Employee Selection Procedures. These guidelines set specific criteria for determining whether a selection instrument is valid and free from adverse impact, as well as stating steps for alleviating these problems when they exist. The Guidelines adopt the use of a four-fifths rule for determining whether adverse impact exists against a minority group. This rule states that the passing ratio for a minority group must be at least 80% of the passing ratio for the majority group. If it is less than 80% for any minority group, then there is adverse impact against that group (U.S. Equal Employment Opportunity Commission et al, 1978). In this case, the guidelines state that the instrument can be used only if one of three types of validity can be shown: criterion; construct; or content. Otherwise, the agency using the instrument must make some type of adjustment to meet the 80% rule.

This paper deals with the development and implementation of a selection measure for use by a large midwestern city. This measure will attempt to meet two goals. First, it will be job-related, and second, it will attempt to satisfy the Uniform Guidelines. The measure will be used to promote members of the Fire Department of the rank of either Firefighter or Firefighter/Paramedic to the rank of Fire Engineer. The Engineer's primary duties are to calculate the amount of pressure

necessary to give the other Fire Department personnel sufficient water to battle the fire. In calculating the pressure, he/she must take into account the diameter of the hose being used, the type of nozzle at the end of the hose, the length of the hose needed, and other factors as well. The force of water delivered is subject to change by either the Lieutenant or Captain who is in charge at the fire scene, but the Engineer must make sure that enough is delivered so that Fire personnel are able to fight the fire, and not too much so as to render the hose out of control of the Firefighters or even to burst.

The last time this exam had been given for this city was in 1978. The results of that test showed there to be adverse impact against Blacks and Hispanics. Therefore, the District Court judge who heard the evidence ordered that promotions to Engineer for each racial group shall reflect the precentages of the candidate pool for those groups. These percentages were 80% white, and 20% minority, and promotions to Engineer reflected these percentages. However, in the six years since that eligible list was posted, all minority candidates have either been promoted to Engineer, or removed from the list due to reasons such as death, retirement, took other positions, etc. So even though there were still white candidates remaining on the eligible list, no more promotions could be made from that list. Therefore it was decided to hold a new exam in order to create a new eligible list.

The last time the test was given, there were two components. One was the written test, and the other was the performance ratings from the Fire Department for each candidate. These were weighted 70-30 respectively to form a final score on which candidates were ranked. A

consultant from Bowling Green State University was hired to help the City with the development and validation of the written test. Based on a job analysis of an Engineer's tasks, a 100 item multiple choice written test was developed. It was developed by members of the Department of Personnel (DOP), as well as subject matter experts from the Fire Department. However, as previously stated, the results of that test proved to be discriminatory against minorities. Therefore, the consultant and the City attempted to defend the exam by proving it to have criterion validity. In order to do this, they correlated the written test scores with several measures of performance specifically designed for that study. Those measures were designed to assess two main areas of an Engineer's job. The first was driving skills, and the second was knowledge of pumping practices. However, the results of that validity study did not prove to be strong evidence of the City's claim of the exam's validity. All of the 100 items on the written test were examined to determine if they could be placed into one of the two categories of skills being measured in the validity study. None of the 100 items on the written test were categorized as measuring driving skills. Fifty-three of the 100 items on the written test were categorized as measuring knowledge of pumping practices. These fifty-three items were split into the areas of pumping computations, pumping knowledge, and pumping rules. Combinations of the 53 items were correlated with the measures used in the validation study. The consultant concluded that only 41 of the total 100 items on the written test were good predictors of performance on the job. He felt that only these should be used to form the basis of a final score, and that the

remaining 59 items should be dropped. The City thought that this was rather drastic and would not leave them with a measure of any worth, so the decision was made by high ranking members of the DOP to use all 100 items. Since the instrument did result in adverse impact against minorities and its validity was not adequately demonstrated, the District Court judge ordered that all promotions based on that exam would be made in equivalent proportions to the candidate pool, as stated earlier.

For the current exam, the City did not hire an outside consultant. Instead we conducted our own analyses. It was decided that the same basic type of written test would be used, only this time on a pass-fail basis, and that a new component would be added which would form the basis of a rank order list. This new component was a practical exam conducted on two large panels which simulate the controls of a fire engine. This part was administered only to those candidates who passed the written test. This practical test was developed by the Department of Personnel and one expert member of the Fire Department who is the Engineer Instructor.

Research of promotional exams in other jurisdictions showed that this type of test has never been used before (K. Long, personal communication, October 7, 1986). The primary type of test used in other jurisdictions was a written test of job knowledge. Other jursidictions in addition to written tests have used performance ratings, seniority, oral boards, or some combination of these, but none have used a practical test of this nature.

The practical test was intended to be a hands-on, job-related

measure of job performance. The Uniform Guidelines state that if a selection procedure does show adverse impact against a minority group, the procedure may still be used if it is demonstrated to be highly job-related. Proving the measure to be job-related is proof of its content validity. The argument for the job-relatedness of the written exam was based on the job analysis. For the current exam, copies of the lists of tasks and knowledges, skills and abilities (KSA's) developed by the 1978 job analysis were sent to subject matter experts from the Fire Department. They reviewed these lists to determine whether or not they were still valid to the job of Engineer in 1984. The new written test items were based on the job analysis update and directly measured knowledge of hydraulics and pumping practices. The exact areas tested, and the number of items in each area, were: Traffic Safety and Accident Policy (4 questions); Defensive Driving (4); Engineer's Manual (19); an Engine Company Hose Record (9); Fire Department Rules and Regulations (7); General Engineer Knowledges (27); and Knowledge of Hydraulic Principles (30). The items were written by DOP staff and members of the Fire Department. Even though the current exam was based on the same information as the test in 1978 which proved to have adverse impact, it was also possible that the candidate population may have changed in the six year interval, and it was possible that adverse impact would no longer be present. In addition, this time the written test was only used on a pass-fail basis to determine who was eligible to take the practical. The practical portion, along with a seniority component, constituted the candidates' final score. However, the Uniform Guidelines do state that not only should the bottom line show no adverse

impact, but any individual component should be free from adverse impact as well. So, even though we performed an update on the job analysis, our main goal going into the written test was to eliminate any adverse impact after this step.

At that point in time, we hoped that there would be no adverse impact to eliminate as a result of the practical test. The intent of the practical test was to closely simulate the actual conditions and duties an Engineer could face at a fire scene. Most important among these is calculating the pressure necessary to deliver water to the Firefighters who are at the scene. Therefore, the practical test was designed to measure how quickly and accurately a candidate could both calculate and then deliver this pressure. In addition to this, the practical test was designed to measure if the candidate could correctly perform a series of related functions. Among these are opening the proper gates, correctly using a safety hitch, opening the front suction, keeping the discharge pressure below 200 pounds per square inch (psi), slowly lowering the engine's revolutions per minute (rpm), closing all gates when finished, and not slamming them shut. Since this test was the first of its type in the country, we had no real a priori beliefs as to whether or not it would show adverse impact. It was our belief that, even if adverse impact was found for the practical, we would be able to defend its use on the basis of content validity. We intended to use content validity as a defense rather than attempt a criterion-related validation study for two reasons. First, it is notoriously difficult, time consuming, and expensive to develop objective measures of performance for the purpose of a criterion validation study. While we wanted

to develop the best instrument we possibly could, we had very real constraints regarding money and man-power, and a validation study was not economical. Second, time and money were put into a criterion-related validation study of the written exam in 1978, and this turned out to be less than useful. We saw no need to repeat the same mistake.

Instead, we reached an agreement with a lawyer from the U.S. Department of Justice in Washington, D.C. This was the same lawyer who reviewed our results from the 1978 test and succeeded in having quotas imposed upon us due to the exam's adverse impact. Under the agreement, he reviewed every step of the procedure as it was being developed, took part in all decision-making regarding the test, and approved what we intended to do before we did it. In this way, we satisfied the Uniform Guidelines at each step of the procedure, and helped to diffuse any problems that arose if the practical test displayed adverse impact. Having direct input in the test decision-making from a federal attorney was also a first for this country.

To summarize, then, we developed a selection measure in order to promote Firefighters or Firefighter/Paramedics to the rank of Fire Engineer. This measure met two criteria. First, it was job-related, and second, it satisfied the Uniform Guidelines on Employee Selection regarding the use of personnel selection measures. This measure met these criteria and was unique in two ways. First, it was the first test of its type in the country to use a practical hands-on test of job performance instead of relying merely on a paper-and-pencil test of job knowledge. Second, it had input into its development and use by a Department of Justice attorney. Previously, he had reviewed our work

after the fact. In these ways, we were setting new standards for future personnel selection procedures.

CHAPTER II

WRITTEN TEST METHOD

Subjects

Subjects for the written test were members of the Fire Department of the rank of either Firefighter or Firefighter/Paramedic and who had completed a one year probationary period in that rank as of the time of application. Approximately 3000 members were eligible to take the test, of which 1150 applied for the written exam. Of this number, 1035 actually appeared for the written test. The racial breakdown for the subjects is 727 whites, 239 Blacks, and 69 Hispanics. Since there is only one woman Firefighter, sex is not a variable. In addition, the male gender will be used in referring to candidates throughout this paper.

Any candidate who failed to appear for either the written test or the practical portion was no longer considered to be eligible for promotion. Therefore, analyses conducted on either portion of the test were confined to the number of candidates who took that portion.

Materials and Equipment

Candidates who arrived for the written test brought with them #2 pencils and their Notice to Report. The Notice was mailed to them by the Department of Personnel and gives the candidate information regarding which room to report to and at what time. A copy of the

Notice appears in Appendix A. Along with the Notice, candidates received in the mail the stub from their application for the exam. The application has two portions, which are joined together. The stub is a detachable portion of the application form which contains the candidate's name, the title of the exam applied for, the date and time the application was received by the Department of Personnel, and a unique sequential serial number. Candidates who brought calculators with them to the written exam were allowed to use them, but they were not required.

At the exam site, candidates were given a standard National Computer System (NCS) Trans-Optic P099B answer sheet with 240 items. A copy of the answer sheet appears in Appendix A. Candidates were also given a fingerprint card. This is printed on a five by eight inch card. The top half is to be filled out by the candidate. There are blanks for name, social security number, birth date, height, weight, and color of eyes and hair. The bottom half contains three boxes where the candidates are to sign and be fingerprinted at the completion of the test. A copy of the fingerprint card appears in Appendix A.

There were two proctors in each room. One was a Proctor-in-Charge (PIC), and the other was an Assistant Proctor (AP). These proctors were teachers from the Board of Education who were on our list of proctors from previous tests. Proctors on our list were sent a notice informing them of the upcoming exam and asking them to call the Department of Personnel if they wished to work. A copy of this notice appears in Appendix A. Proctors received $35 for the day's work.

Each proctor received a Proctor Guide after checking in at the

written exam site. The Guide contained general rules for the exam, a statement of understanding for the proctors to sign and turn in, and specific instructions to the proctors regarding the set up of the rooms and the test procedure. A copy of the Proctor Guide appears in Appendix A.

Proctors also received, at time of check-in, an assignment card. This card contains the proctor's name, the designations AP, PIC, and Hall, one of which was circled once the assignment was made, a space for room number which was filled in when that assignment was made, and a line on which the proctor was to sign once he or she had checked in. A copy of this assignment card appears in Appendix A.

Department of Personnel staff at the written exam site had two computer generated sheets which contained the numbers of all rooms to be used in the exam down the left hand side. One sheet was used for the APs and the other for the PICs. Proctors signed in immediately to the right of their room number and, at the conclusion of the test, signed out immediately to the right of that.

The PICs received the test booklets for their room. The test booklets were packaged so that each room received exactly its capacity. Each booklet contained 22 pages and a total of 100 multiple choice items. For security reasons, a copy of the booklet cannot be provided here. The cover contained the title and date of the exam, and the name of our department and commissioner. Directions to the candidates were also printed on the cover and read as follows:

> ONLY TEST MATERIALS GIVEN TO YOU BY THE PROCTOR SHOULD APPEAR ON YOUR DESK. TAKE ALL OTHER MATERIALS OFF YOUR DESK.
>
> This is your written examination booklet. It contains 100

questions and 22 pages. You will have three hours to complete this test. (The time limit is set to allow almost all candidates to finish if they work steadily.) The Answer Sheet given you is to be used with this booklet. Directions for the use of the Examination Booklet and the Answer Sheet appear on the back of this booklet.

When told to do so, and NOT BEFORE, count the pages in your test booklet to see that it is complete. THIS IS YOUR RESPONSIBILITY. Then close your booklet and do not open it again unitl you are told to do so.

Page 1 of the booklet contained a Hensel chart showing pressures for various nozzle pressures and tip sizes. A copy of the Hensel chart appears in Appendix A. The remaining pages 2-21 contained the items, with more directions on the inside and outside back cover. The directions on the inside back cover read as follows.

WHEN YOU HAVE FINISHED THE EXAMINATION PLACE ALL TEST MATERIALS INSIDE THE TEST BOOKLET. THEN RAISE YOUR HAND TO SIGNAL THE PROCTOR THAT YOU ARE READY TO LEAVE. When the Proctor-in-Charge indicates that it is your turn to hand in your papers, go to the front of the room. Give ALL test materials to the Proctor-in-Charge.

REMAIN WITH THE PROCTOR-IN-CHARGE UNTIL HE SIGNS THE BOOKLET RECEIPT FORM, INDICATING THAT YOU HAVE RETURNED YOUR TEST BOOKLET.

When you have witnessed the signing of the booklet receipt, the Proctor will check your fingerprint card. Go directly to the fingerprint station. You MUST be fingerprinted before you leave the building. Leave the building immediately after being fingerprinted. You will NOT be permitted to loiter in the building.

The directions on the back cover read as follows.

This page contains directions on the use of the separate ANSWER SHEET which has been handed to you.

Each of the questions in this booklet has several suggested answers, lettered "A", "B", "C", and "D" (some questions may also have an "E" answer.) Read each question and its lettered answers in the Examination Booklet. When you have decided which answer is correct or most nearly correct, blacken the circle on your ANSWER SHEET which is lettered the same as the answer you have selected. Be sure that the space you mark is in the row numbered the same as the question you are answering. Look carefully at your ANSWER SHEET. Note that the questions are numbered down the page.

Now look at the Sample in the box below. Have you blackened in space "B" within the circle the same way?

NOTE: 1. Use only a No. 2 pencil for marking.

2. Make solid marks, heavy and black, that fill the circle

completely.
3. Mark only one answer for each question.
4. Do not make any stray marks on the Answer Sheet.
5. Erase completely any answer you wish to change.

Now fill in the example on SIDE ONE of the Answer Sheet.

Note that items 1 through 10 go down the page to the double line. In the next column are items 11 through 20 and so on through item 60. Item 61 is below the double line in the first column.

The proctors also received a Booklet Receipt Form on which they recorded the number of each booklet passed out to candidates and a space to initial when the booklets were returned at the end of the exam. The booklet numbers were stamped on the upper right corner of the covers of each booklet. A copy of the Booklet Receipt Form appears in Appendix A. As candidates left the written exam site after being fingerprinted, they were given a receipt form. This was printed on eight and one-half by eleven inch yellow paper. Candidates turned this form in to their commanding officer in order to prove that they actually were at the exam site. This was necessary due to the fact that many of the candidates were scheduled to work their regular shift that morning, so the Fire Department had to call many other employees back at overtime rates in order to be properly manned, and the Fire Department had agreed to pay all employees regularly scheduled to work but who took the exam. Therefore it was necessary for those employees to prove that they were at the exam site. A copy of this receipt form appears in Appendix A.

Procedure

In 1984, the Department of Personnel announced that applications would be taken for the position of Fire Engineer. Copies of the announcement were distributed throughout the city, as well as posted in City Hall. The announcement listed job duties, salary, requirements,

and when and where to apply. A copy of the announcement is provided in Appendix A. Applications were accepted from August 14, 1984, through September 28, 1984. Candidates were given a copy of the announcement at the time of application.

Once the deadline for submitting applications had passed, the DOP scouted various high schools in the city to use as the site of the written exam. We needed one high school which was large enough to be able to hold almost all of the applicants. Based on past testing experience, the no-show rate for written exams was usually 30%. However, the no-show rate tended to be much lower for promotional exams such as this one. Therefore, we needed a high school which could easily hold 1000 people. In addition, rooms were not overbooked as they usually are, since we expected a high turnout rate. We were easily able to find a school which met our needs, and this was decided on as the site for the written test.

Notices were then sent out to Board of Education teachers on our proctor list from previous exams informing them that the test would be given and asking them to call us if they wished to work. A copy of this notice appears in Appendix A. The proctors who responded were told when and where to report, and their names were recorded on a list by the DOP clerical staff taking the calls.

Next, the Notice to Report was mailed to all applicants. This informed the candidates of the date, time, and location of the test, as well as the room number to which they were to report. A copy of this appears in Appendix A. Candidates were told to bring their Notice with them to the written test, as well as No. 2 pencils.

Candidates were assigned to a room alphabetically by DOP clerical staff. We had an alphabetical list of all applicants, and a list of all rooms to be used at the high school. Assignments were made to a room from the applicant list until the room's capacity was reached, and then assignments to the next room were begun. However, if two candidates had the same last name, they were assigned to separate rooms, with the second person going to the next room on the list. This was done in order to attempt to separate candidates who were related.

During the week prior to the written test, the test booklets were printed. Approximately 1400 booklets were printed on January 16. They were stored in the DOP vault until the day of the test. Also during this week, copies of the Proctor Guide were distributed to DOP staff members who would be working at the exam site. A copy of the Proctor Guide appears in Appendix A. Department of Personnel staff worked as either Hall Proctors, Room proctors, or in the office. Hall Proctors were responsible for seeing that everything in the rooms they were assigned to watch went as smoothly as possible. They made sure that rooms had enough materials, set up quickly, finished at the appointed time, checked to see that the PICs and APs were watching the candidates, and reported any serious problems to the Office. One Hall Proctor on each floor was designated the Floor Proctor for that floor, and so in charge of all Hall Proctors on that floor. In the event of any room not having two proctors, a DOP member filled in as the AP and assumed all duties normally performed by the AP. These duties will be discussed later. Department of Personnel staff assigned to the Office were responsible for all the paperwork. They made sure that all proctors

signed their assignment cards and sign-in and sign-out sheets, checked all materials when returned, counted test booklets to make sure all were returned and with all their pages, and filled out new Notices for any candidate who either forgot or lost theirs.

One member of the DOP staff was appointed the Examiner-in-Charge (EIC) for the school. He was the final authority for any problem that arose during the test. A second was appointed the Assistant Examiner-in-Charge (AEIC). He was responsible for briefing the proctors just prior to the test, for periodic checking of the rooms, resolving small problems, and reporting large problems to the Office and the EIC.

The EIC conducted the briefing for DOP staff in the week prior to the written test. The purpose of this briefing was to go over rules of the test for any new employees who may not have worked an exam before, to distribute and review the Proctor Guide, and to discuss the DOP staff assignments made by the EIC for the test.

The written test was held on Saturday, January 19, 1985. The EIC transported the test booklets and other materials from the DOP vault in City Hall to the exam site. All other DOP staff reported directly to the exam site. Once there, the DOP staff prepared for proctor sign-in by placing the sign-in sheets on a table, removing the test booklets from boxes, and alphabetizing the proctor assignment cards.

When the DOP staff were ready, the school doors were opened. As people entered, DOP staff checked Notices to see if they were proctors or candidates. Proctors were told to check in, and candidates were told to wait in the hallway. Normally, candidates are not allowed to enter the school until all rooms are prepared by the APs and PICs, but this

particular day was bitterly cold, so we allowed them to wait in the hallway.

As proctors checked in, their names were checked against our list of proctors who had agreed to work. They were then given their assignment card, which they signed and held until the end of the test. All proctors who arrived first were assigned as PICs until all rooms had a PIC. At that point, all subsequent proctors were assigned as APs. After all rooms had two proctors, others were assigned as Hall Proctors. Assignments to rooms were made in numerical order. After they received their assignments, the proctors then signed the appropriate sign-in sheet next to their room number.

At this time, proctors received the test materials. Those assigned as PICs received the test booklets, the APs received kits containing answer sheets, pencils, fingerprint cards, and the Booklet Receipt Form, and Hall Proctors received a kit containing extra answer sheets and fingerprint cards. For the PICs, the numbers of the booklets they received were recorded on the far right of the sign-in sheet, on the same line as the proctor's room number. All proctors regardless of assignment received a Proctor Guide. After this, they were told to wait in the auditorium for the briefing.

The DOP member assigned as the AEIC conducted the proctor briefing. The purpose of the briefing was primarily to review the rules of the test, and the Proctor Guide. First, the AEIC asked all PICs to check their test booklets to make sure they had the booklet numbers that were printed on the shrink wrap cover. If they were missing booklets, they were told to raise their hand and we gave them more booklets. The

numbers of any additional booklets given to PICs were also recorded on the proctor sign-in sheet.

At this point in the briefing, the AEIC asked the proctors to turn to the second last page of the Proctor Guide, which was test rules. The AEIC read these aloud. He then asked them to turn to the last page which was the proctor Statement of Understanding. The proctors were told to read this page and sign at the bottom of the page. These were then collected by DOP staff. The AEIC continued on with the briefing. He covered point by point the instructions printed in the Proctor Guide. He informed them that what is printed in capital letters in the Guide is to be read verbatim to the candidates. The AEIC also pointed out what the proctors' specific duties are. Specifically, the PIC is in charge of the room. The PIC writes directions on the blackboard, reads the directions to the candidates, helps check papers as candidates turn them in, and puts materials in proper order for check-out. The AP assists the PIC. The AP places answer sheets and fingerprint cards on the desks in the room. The AP assists in checking papers as candidates turn them in, and helps put materials in proper order for check-out. At the briefing, the proctors were also told not to sit during the test, but to walk around the room and check on the candidates. At the conclusion of the briefing, the proctors were dismissed to begin preparing their rooms.

Specific instructions to the proctors regarding the set up of the room, and directions to be read to the candidates, are contained in the Proctor Guide. After reaching their rooms, the PIC wrote on the blackboard the name of the school, the date, the exam, and the room number.

The PIC also wrote the examples on page 1 of the Guide on how to fill in the name, identification number, and special code sections of the answer sheet on the board. At the same time, the AP placed a fingerprint card and answer sheet on every desk in the room.

Once the rooms were prepared, and at the time designated by the EIC, the candidates were allowed to proceed to their rooms. Proctors stood in the entrance to their rooms and checked the Notices. If candidates were at the wrong room, they were directed to the proper room. If candidates did not have a Notice, proctors instructed them to report to the Office. There, the EIC checked their name against our list of candidates who had applied. If their name was on the list, a Notice was made out for them there by the EIC. They then reported to their rooms. If a candidate's name was not on our list, the EIC made a Notice for him, sent him to the room, and wrote the candidate's name, social security number, and room assigned to at the bottom of the list.

Approximately 15-30 minutes after the candidates reported to their rooms, the proctors proceeded. The PIC in each room followed numbers 3-9 as printed in the Proctor Guide in Appendix A.

During the test, proctors walked about the room, checking that candidates were filling in answer sheets properly, and checking that no candidate was cheating. Hall Proctors looked in on their rooms to make sure the PICs and APs were circulating and not sitting at the desk. The Hall Proctors also recorded the Start Time, Stop Time, and Room Count as written on the blackboard by the PIC. These were then turned in to the Office by each floor's Floor Proctor.

As candidates finished, the PICs and APs followed steps 10-14 of

the Proctor Guide regarding collection and organization of materials. Candidates were also given their Proof of Attendance Form to be turned in to their commanding officer. Once a candidate checked out of a room, he was directed to the first floor to be fingerprinted. Three stations for fingerprinting were set up by stairways on the first floor. The fingerprinting was done by Fingerprint Technicians from the Police Department. The candidates were fingerprinted in box 1 on the card. After being fingerprinted, candidates left the school.

When all candidates from a room had finished, the proctors organized the materials according to the instructions in the Proctor Guide and reported to the Office. In the Office, DOP staff checked that the numbers of the booklets turned in for a room matched the numbers of the booklets assigned to that room, as recorded on the PIC sign-in sheet. The DOP staff checked that the Booklet Receipt Form was included and signed by the PIC. The DOP staff also checked that the Notices were returned and alphabetized and that the answer sheets were in alphabetical order. Once all these were checked, proctors were allowed to sign out on their respective sheets. They signed out immediately to the right of where they had signed in. The proctors also turned in their assignment cards. These were used later by our clerical staff to produce the payroll for proctors for that exam. Proctors then left the school.

As the test booklets were checked in at the Office, DOP staff members brought them to the basement. There, the test booklets were burned, except for approximately 100 which were kept for future reference. After all candidates and proctors left, and all booklets were burned, the test materials were returned to the DOP vault in City Hall.

The following week, the test papers were scored by our Scoring section using an answer key and our scoring machine. The results of the written test, and its impact on the practical portion, are discussed in the Written Test Results section. After the papers were scored, and scoring decisions made by officials of the DOP, score notices were mailed out to all candidates. A copy of both the passing and failing score notices appear in Appendix A.

CHAPTER III

WRITTEN TEST RESULTS

The first step taken in examining the results of the written test was to conduct an item analysis. The main purpose of the item analysis was to determine whether any items were flawed and should be removed, or double-keyed. A list of the 100 items, along with the percentages of candidates answering them correctly and the point-biserials is presented in Table 1.

Based on the item analysis, six items were identified as being possible problems. These were items 5, 23, 26, 56, 64, and 65. As can be seen in Table 1, for each of these items, less than 30% of the total group answered them correctly. The items were reviewed by members of the DOP, as well as by subject matter experts to determine whether the items were indeed correct as written. The review concluded that the items were correct. Therefore, it was decided that these items were too difficult, and so were dropped from further consideration at that point. It has been our practice to do this with previous exams, so this was not an unusual or unprecedented decision.

In addition, item 52 displayed a negative point-biserial, which would indicate a negative correlation between answering the item correctly and overall success on the test. However, this item was also reviewed by the DOP staff and experts from the Fire Department and it

Table 1

Item Analysis From the Written Test[a]

Item	Percentage of Correct Answers	Point Biserial
1	46.85	.3821
2	47.53	.2049
3	44.92	.3419
4	51.02	.3705
5	22.07	.1009
6	88.29	.2002
7	81.99	.2960
8	70.47	.2343
9	69.31	.3089
10	33.98	.3566
11	92.06	.2722
12	74.25	.3075
13	61.08	.4246
14	67.67	.4723
15	89.35	.1050
16	74.64	.2999
17	61.47	.3845
18	75.02	.3748
19	45.89	.3896
20	73.67	.2355
21	59.63	.3304
22	80.83	.3883
23	21.88	.2734
24	87.12	.1803
25	70.96	.3751
26	27.88	.0802
27	58.57	.1693
28	90.03	.2503
29	95.55	.2162
30	86.74	.2916
31	94.77	.2728
32	97.68	.1399
33	81.12	.2568
34	98.26	.1385
35	96.90	.2236
36	81.70	.2453
37	83.35	.3371
38	74.54	.4839
39	64.47	.4483
40	70.67	.3741
41	85.48	.1621
42	52.27	.3873
43	44.82	.0409

Table 1 (Continued)

Item Analysis From the Written Test

Item	Percentage of Correct Answers	Point Biserial
44	73.38	.2653
45	53.44	.2374
46	73.67	.5171
47	61.08	.5315
48	70.96	.2724
49	76.28	.5475
50	55.86	.2895
51	34.27	.3118
52	50.63	-.0935
53	92.35	.1635
54	85.96	.3574
55	72.51	.3061
56	28.27	.1629
57	32.72	.0417
58	61.37	.4591
59	78.61	.5009
60	79.28	.4904
61	77.54	.4876
62	65.54	.4636
63	53.24	.4653
64	25.46	.2361
65	20.72	.0815
66	60.89	.5405
67	68.34	.2269
68	39.98	.4342
69	57.79	.4241
70	68.44	.4961
71	40.95	.1013
72	53.82	.5014
73	45.98	.3587
74	38.14	.2701
75	53.05	.1818
76	44.53	.4566
77	59.92	.5412
78	46.95	.4669
79	58.28	.5070
80	52.18	.2594
81	66.31	.4939
82	48.89	.2912
83	36.30	.3241
84	64.76	.6467
85	68.44	.6037
86	67.38	.5741

Table 1 (Continued)

Item Analysis From the Written Test

Item	Percentage of Correct Answers	Point Biserial
87	61.08	.5884
88	49.76	.5372
89	64.28	.3726
90	61.47	.5556
91	68.44	.5535
92	74.06	.4770
93	62.54	.5866
94	60.21	.6604
95	63.12	.6188
96	61.96	.5062
97	46.95	.2869
98	55.95	.3490
99	33.11	.2625
100	61.08	.5050

[a] $n = 1035$.

was determined that the item was correct as written, and so it was left in the scoring. No other items were identified as being specifically problematic. This left 94 items to form the basis of the written test score.

Next, raw scores were computed for all candidates. Raw scores were simply the amount of items correct using the 94 remaining. After that, the mean raw scores for each race group, as well as the mean for the total group, were computed. These figures are presented below in Table 2.

Table 2

Descriptive Statistics From the Written Test

Group	Mean	S.D.	N
Whites	63.5779	15.3488	727
Blacks	54.6067	13.8702	239
Hispanics	58.8986	13.7233	69
Total	61.1897	15.3768	1035

A one-way analysis of variance revealed the difference in raw scores to be significant, $F(2, 1033) = 18.13$, $p < .01$. The proposed passing point for the written test was a score of 60. This was the passing point for the previous test, so it was used as a preliminary cutoff here. Setting that as the passing point yielded the following results listed in Table 3.

Table 3

Preliminary Passing Point for the Written Test

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	727	437	60.11	----
Blacks	239	88	36.82	61.25
Hispanics	69	33	47.83	79.57
Total	1035	558	53.91	

As can be seen in the column labeled % White Rate, setting the passing point at a raw score of 60 would have resulted in adverse impact against Blacks and Hispanics since their passing rates were less than 80% of the passing rate for whites. Therefore, according to the Uniform Guidelines, we needed to take some action to alleviate the problem.

Even though we had updated the job analysis, the lawyer from the Justice Department did not feel that this was sufficient to defend the results of the written test on the basis of content validity. Therefore, it was decided to standardize the raw scores. This decision was made at a meeting with officials of the DOP and the Justice Department lawyer. We had two basic courses open to us. One was to standardize each of the race groups to the mean and standard deviation of the total group. The second was to standardize the Black and Hispanic groups to the mean and standard deviation of the whites. There were pros and cons for each method. The pros for the first method were that we would be standardizing basically on a color blind system. That is, in standardizing each of the three race groups to the total mean, all of the groups are affected regardless of their distributions.

The end result would be the same distribution for all three groups. The cons for this method were that the means, and thus individual scores, for Blacks and Hispanics were being raised, while the mean, and individual scores, for whites was being lowered. White candidates would feel that their scores were being arbitrarily lowered just to pass more minorities.

For the second method, the main advantage was that scores for white candidates would not be lowered. They would stay exactly the same. This would eliminate what is the major problem of the first method. The con, however, was that scores for Blacks and Hispanics would be raised to an even higher mean than they would have been in the first method. This may have resulted in aiding them too much. The Justice Department lawyer preferred the first method since we were applying the same correction to all groups, regardless of race. Since we wanted his approval in order to avoid going to court, it was decided to use the first method.

Standardizing all three race groups to the mean and standard deviation of the total group, and using a standardized score of 60 as passing, produced the results presented below in Table 4.

Table 4

Passing Rates Standardizing to the Overall Mean

Group	No. Passing	Pass Rate	% White Rate
Whites	392	53.92	-----
Blacks	125	52.30	96.99
Hispanics	38	55.07	102.13
Total	555	53.62	

As can be seen in Table 4, we now met the 80% rule for both Blacks and Hispanics.

However, even though this method would suit our needs and was approved by the Justice Department, our Deputy Commissioner still felt that whites were being adversely affected by the result and that we would have a very real problem explaining it to the Fire Department officials and to candidates. Therefore, a compromise was reached. Due to the standardization, a white candidate could have a raw score greater than 60, but a standardized score of less than 60 and so not pass. The compromise allowed all candidates with a raw score of 60 or greater to pass in addition to anyone with a standardized score of 60. In this way, white scores would not be lowered. In addition, the Fire Department had been pressuring us to reinstate the six items dropped at the beginning. The reason they wanted them back in was primarily racial. The top officers of the union, including the president, are all white, and the vast majority of union members are white. So, while the leaders wanted to represent all the members of the union, in reality they were mainly concerned with getting a fair shake for whites. The union leaders felt that, while overall very few candidates answered these items correctly, the ones who got them correct were predominantly white. Therefore, putting these items back into the scoring helped whites and made the union leaders look good to their leadership. So, a compromise was reached with them. Any correct responses to the six items would be counted towards a raw score of 60, but we would not recalculate the means and standard deviations and change the standardization. A standardized score of 60 was still passing, but also now, any candidate who

had 60 out of the total 100 items correct would also pass. Since the means were not recalculated, no new minorities passed. This did result in an additional 62 whites passing. As can be seen below in Table 5, adding the 62 whites lowered the passing ratio for Blacks and Hispanics compared to whites, but both still met the 80% criteria. Therefore, this method was approved by the Justice Department and score notices were sent to all candidates. Copies of these appear in Appendix A. The final passing rates are presented below in Table 5.

Table 5

Final Passing Rates From the Written Test

Group	No. Passing	Pass Rate	% White Rate
Whites	454	62.45	-----
Blacks	125	53.19	85.17
Hispanics	38	55.07	88.18
Total	617	59.61	

Therefore, a total of 617 candidates were eligible to take the practical.

CHAPTER IV

PILOT TEST METHOD

Subjects

Subjects for the pilot test of the practical portion were incumbent Engineers from the Fire Department. The Engineers were picked at random, but stratified to reflect the racial composition of Engineers in the whole Department. A total of 80 Engineers were used, with the racial breakdown being 54 whites, 22 Blacks, and 4 Hispanics.

Materials and Equipment

For the practical and pilot parts of the test, there were no outside proctors used, only Department of Personnel staff and one member of the Fire Department. For the pilot, two rooms were used at the Fire Academy, with two DOP staff members to each room. Each room contained a simulator and a control board. A simulator is a panel which simulates as closely as possible the controls of a fire engine. Each room contained a different simulator since there are two different types of engines used by the Fire Department. One was a Hale, and the other a Waterous. The simulators, as well as the control boards, were built to the Fire Department's specifications by the Fire Research Corporation of New York. Pictures of these appear in Appendix B.

Figure 1 in Appendix B shows the Hale simulator. All controls are clearly marked for the candidates. The Hale simulator is 64" high, 36"

wide, and 22" deep. The top row is labeled 1 in Figure 1. The left-most control is the relief valve. To its right is the suction gauge, then the main pump pressure gauge. The two smaller dials at the right are gauges for water temperature of the radiator and oil pressure. The four lights immediately below are water level indicators. From left to right in the row labeled 2 are the air pressure gauge for clearing out the hard line hose, a set of panel gauge lights, the tachometer, and the Discharge 5 gauge. The three handles in row 3 are the front suction, the hose reel, and the Discharge 5 valve. The two sets of dials and handles in row 4 are the Discharge 3 and 4 gauges and handles. In row 5 are the Discharge 1 and 2 gauges and handles. Row 6 shows the throttle, Discharge 1 port, transfer valve, Discharge 2 port, and the tank-to-pump valves. Working down from the top left of row 7 are the primer, a pump cooler, an auxiliary pump cooler, and the main pump drain. The large opening at the center is the auxiliary side intake. Just above it to the left and right are the Discharge 1 and 2 bleeders. A smaller auxiliary intake is to the right of the auxiliary side intake, and below that is its bleeder. Finally, the handle at the lower right is to open the auxiliary intake.

Figure 2 in Appendix B shows the Waterous simulator. This is 61" high, 38" wide, and 30" deep. From left to right in row 1 of Figure 2 is the compound gauge, tank water level indicators, the tachometer, the panel gauge heater, and the main pump pressure gauge. Row 2 shows a panel light switch, an am meter for measuring amps, the water temperature gauge, oil pressure gauge, and a reel rewind switch. The five dials in row 3 are the pump pressure gauges for Discharges 1-5. In row

4 is the air pressure gauge for clearing out the hard line, a tank fill and recirculating valve, a reel discharge valve, an engine cooler valve, a pressure relief valve with a smaller 4-way valve just below it, and an electric transfer switch. Row 5 contains the #4 Discharge valve, #1 Discharge bleeder and #1 Discharge port, #1 Discharge valve, #3 Discharge port and #3 Discharge bleeder, #3 Discharge valve, relief valve indicator lights, a pump mode indicator light just below, a tank discharge valve, and the throttle and primer. In row 6 is the #5 Discharge valve, #2 Discharge valve, #2 Discharge bleeder, #2 Discharge port, and #2 Discharge valve. In row 7 is the auxiliary intake valve, a small auxiliary intake port, a front suction valve, a large auxiliary intake port, the main pump drain, and a manual pump shift to dis- and reconnect the transmission.

Attached to the top of both simulators was a Hensel chart which lists the pressures necessary for certain types of nozzles and hoses at various lengths. This is exactly the same as the Hensel chart which appeared in the written test booklet. A copy of this appears in Appendix A. On the reverse side was a chart showing the gallons per minute flowing at various nozzle pressures and sizes. These charts were encased in clear plastic. A copy of the reverse side showing the gallons per munite appears in Appendix B.

Each simulator was connected to a control board. Unlike the simulators, the two boards are identical. Each produces a digital readout of the nozzle and discharge pressures set on the simulator by the candidates. This enabled the DOP staff to record a precise reading for each setting. A picture appears in Figure 3 in Appendix B.

Each control board is 35" wide and 24" deep. The faces are a red metal angled at 45 degrees with the viewing height approximately 40" high. The bottom row labeled 1 in Figure 3 are connections for eight Discharge gates. All eight were not used since each simulator only has five Discharge gates. Only four were used, one for each problem. The ones that were used were connected by banana plug to one of the row of switches labeled 2 in Figure 3. This row regulates the diameter of the hose, varying from one and one-half inches on the left to five inches on the right. The length of hose is regulated by the knobs at the top. The "Fail" buttons simulate a burst line of hose. This was then connected by banana plug to the row which controls the type of nozzles, labeled 4 in Figure 3. The row of controls labeled 3 controls various options not used in this test. From left to right, the first two allow for Y nozzles, the next two control the elevation, and the last is for using a sprinkler standpipe. The top row of switches labeled 5 are the open and close switches for each Discharge gate. The switch for a particular gate must be open in order to read the Discharge pressure on the board.

There are two columns of controls to the right, labeled 6 and 7. Going down in column 6, this box produces a digital readout of the nozzle pressure in 1" numbers. The box immediately below produces the pump pressure. Below that is a knob which controls which Discharge gate's reading will appear. Below that is a knob for controlling the hydrant pressure (usually 30-32 psi). Below that is a knob to change the water source from hydrant to tank, draft or relay. If the relay is set, it must be connected to the bottom control labeled "Relay".

At the top of column 7 is the switch to control which Discharge gate's nozzle pressure will be displayed. Below that is a knob which controls the temperature of the water in the radiator. Below that is a knob to control the oil pressure. Below that is a knob to control the air pressure in the tanks used to blow out a hard line (hose) after its use and before being wrapped up and returned to the engine. Next is a switch to control the pump size (750, 1000, 1250, 1500, 1750, or 2000 gpm). Next is the switch to control the level of water in the tank. Immediately to its left is an open-close switch for the tank. The last switch is the on-off switch with a pilot light on the left and a fuse on the right.

Most of these options were not used for this test. There were only three variables used in the pilot. The type of nozzle was either a 100 gpm adjustable fog, a 250 gpm adjustable fog, a one and one-quarter inch, or a task force tip. The second variable was the diameter of the hose. This was either one and one-half inches, two and one-half inches, or three inches. The third variable was the length of the hose. This ranged from 100 to 500 feet in increments of 100, with one exception being a length of 150 feet used for one problem.

On the front side of the control boards is a radio. By switching this on, the speaker can communicate to a candidate through a speaker. This simulates a commanding officer who is in a burning building giving orders to the Engineer via radio. However, this feature was also not used in this test.

The DOP staff used MacGregor 100 stop watches to record the time it took the subjects to calculate an answer or produce a setting. These

produce a digital readout to the hundredth of a second. Special answer sheets were used by DOP staff to record candidates' responses. These answer sheets were created specifically for this test. On it were recorded the date, the candidate's name and social security number, the type of simulator, and the initials of the two DOP proctors. For each of the four problems, there were spaces to record the problem number, calculated answer and time needed to produce it, the tachometer reading, nozzle pressure, and whether the candidate correctly performed a series of related functions. A copy of the answer sheet appears in Appendix B.

The DOP staff also had a Proctor Guide which they followed in administering the pilot test. A copy of the Proctor Guide appears in Appendix B.

Procedure

The first step in the pilot test was to select the Engineers to be used. To do this, six envelopes, one representing each district in the city, were assembled. Each envelope contained slips of paper with the numbers of all the engine companies within that district. One slip of paper was randomly selected from each of two envelopes for each appointment time (9:00 and 1:00) each day.

Two engine companies were selected at approximately 4:00 p.m. each day for the pilot study the next day at 9:00 a.m. Two additional engine companies were selected at approximately 9:00 a.m. for the pilot study that afternoon at 1:00 p.m. Once an engine company number was used, it was not eligible to be used again. In addition, once our quota for a particular race group was filled, if an engine company whose Engineer

was of that race group was drawn, it was not used and another company was drawn. The engine companies at the airport were not included in this process due to difficulties in replacing them when taking them out of service.

The items used in the pilot study were drawn up by the Fire Department official who is in charge of Engineer training. As stated earlier, the three conditions in each problem which varied were the length of the hose, the diameter of the hose, and the type of nozzle used. Two sets of four problems each were used. The problems in the first set were numbered 1-4, and those in the second set were numbered 96-99. Problems 1 and 98 were designed to be parallel in that the only difference between the two problems was the length of the hose. In like manner, problems 2 and 96 were parallel, 3 and 99, and 4 and 97. A set was picked at random for a day's use at the beginning of the day, and that set was used for the entire day. This was done in order to randomly balance the problem sets across race of the subjects.

Prior to the Engineers arriving at the Fire Academy, the Engineer Instructor made all the connections on the simulator control boards, making sure that the Discharge gates being used were properly set up. Two DOP staff were assigned to each simulator. Their duties were to read the instructions from the Proctor Guide, record the subjects' answers and their response times, and check the behaviors listed on the answer sheet. One of the DOP staff recorded all responses while the second verified the accuracy of the recordings. All of the DOP staff received training in the use of the simulators prior to the pilot study.

When the Engineers arrived, one was assigned to the Hale simu-

lator, and one to the Waterous. The DOP staff followed the directions in the Proctor Guide in Appendix B in administering the pilot. Instructions in capital letters were read to the subjects verbatim. The subjects were read a problem. Their answer and the time it took to calculate it were recorded on the answer sheet. They were then instructed to deliver the calculated pressure on a particular discharge gate on the simulator. Their actual setting was recorded, as well as the time it took the subjects to deliver it. At that point, the subjects were told to step away from the simulator, and the DOP staff inspected all the controls in order to check off whether the subject correctly performed the duties listed on the answer sheet. When the recordings were made, the subjects were told to shut down the line as if they were going back to quarters. Then this procedure was repeated for the next three problems, with the exception of the third and fourth exercises. After the third exercise, subjects were not told to shut down the line. The fourth exercise given to the subjects was to be added on to the line already used for the third exercise. After the fourth exercise, the subjects were then told to shut down the lines as if they were returning to quarters. When all four exercises were completed, the Engineers were allowed to leave.

CHAPTER V

PILOT TEST RESULTS

Once the data from the pilot test had been gathered and entered onto our computer system, the next step was to create a score based on the responses recorded on the answer sheet. A complicated scoring method was worked out. We began with a base total of 100 points. Since there were four exercises, each exercise was worth 25 points. In each exercise, there were two main components. One was calculating and setting the pressure, and the other was performing correctly the series of related duties. The 25 points per exercise were divided so that each of the two main areas was worth 12.5 points. Discussions between the Engineer Instructor of the Fire Department and members of the DOP resulted in four policies regarding scoring. First, it was decided that being able to calculate the pressure needed quickly and accurately was slightly more important than being able to set the pressure quickly and accurately. Therefore, of the 12.5 points of each exercise to be accounted for by this, 55% would come from calculating the pressure, and 45% would come from setting the pressure. Second, it was also decided that it was just as important in both calculating and setting to be fast as it was accurate, so the weightings for accuracy and speed are equal in the scoring. Third, it was decided that the related duties comprising 12.5 points of each exercise should be equally weighted. Therefore,

for a given exercise, the number of duties to be checked were divided into 12.5 to determine the number of points for each item. Lastly, it was decided that there should be ranges of acceptability in the accuracy and speed in setting and calculating the pressure. So, beginning with a base of 5 points, the farther a candidate was from the correct answer or the desired setting, the fewer points achieved, down to a minimum of zero. The candidate would lose one point for every 10 pounds, plus or minus, from the correct answer. For setting, the candidate would lose one point for every 5 pounds, plus or minus, from the calculated answer. For speed, beginning with a base of 5 points, the longer it took a candidate to calculate or set the pressure, the fewer points achieved, down to a minimum of zero. The candidates would lose one point for every 30 seconds it took in both setting and calculating. It must be noted that there were no real scientific criteria or data as a basis for the four policies used in the scoring. They were merely the result of discussions among the Engineer Instructor and DOP officials, and primarily reflected what the Instructor considered to be most important to the job of Engineer.

To illustrate the scoring method, suppose the correct answer for a problem was 90. The candidate's answer was 103 and it took 20 seconds to give that answer. Then, when setting the pressure on the simulator, it read 107, and it took 71 seconds. To determine the score for the calculation aspect, we would compute the difference between the calculated and correct pressure. This difference is 13. Losing one point from a high of 5 for every 10 pounds, this candidate would get 4 points. This is multiplied by .55 (55%) to give 2.2 points. For speed, it took

20 seconds, so beginning with a base of 5 and losing one for every 30 seconds, the candidate would get 5 points. This is also multiplied by .55 to give 2.75. The 2.2 and 2.75 points are summed to result in 4.95 points for calculating the answer. This is the candidate's Engine Pressure Calculation Score (EPCS) for that problem.

For setting the pressure, the setting produced is compared to the candidate's calculated answer, no matter how far off it may be from the correct answer, because that is what the candidate is attempting to deliver. In this case, the calculated answer was 103 and the setting read 107. Beginning with 5 points and losing one for every 5 pounds difference, the candidate gets 5 points. Multiplying by .45 (45%) results in 2.25 points. For the speed, it took 71 seconds. Beginning with 5 and losing one for every 30 seconds would give this candidate 3 points. This multiplied by .45 gives 1.35. Summing 2.25 and 1.35 gives 3.6 points on setting the pressure. This is the candidate's Engine Pressure Setting Score (EPSS) for that problem. Adding the 4.95 points from calculating and the 3.6 from setting gives 8.55 points out of the 12.5 allocated for calculating and setting for that exercise. This is the candidate's Total Engine Pressure Score (TEPS) for that problem. It should be noted, however, that due to this method, scoring the maximum points for speed and accuracy in both calculating and setting would result in only 10.0 points for this half of each exercise. Therefore, the highest possible score would be 90, not 100. It should also be noted that there were three possible methods a candidate could use to determine the amount of pressure needed, and those methods would usually result in different answers on the same problem. These methods are flow

memory, a hydraulic friction-loss formula, and the Hensel chart. Any of these is an acceptable method. For the pilot, after the Engineer Instructor wrote all eight problems, he then computed the pressures on all eight for each of the three methods. He took the average of the three pressures as the answer for the problem. A different method was used in the actual practical test and that will be discussed later.

For the other 12.5 points of each problem, this came from the yes-no items on the answer sheet checked off by the DOP staff. The point value of each item was determined by dividing 12.5 points by the number of items to be checked. For all those performed correctly, the candidate received those points. These were summed to form the candidate's Yes Score (YSC) for that exercise. Then, the TEPS and the YSC were summed to form a Total Score (TOTSC) for that exercise. The four TOTSCs were summed to create the final score.

After computing final scores, we examined the balancing of problem sets. The results are presented in Table 6.

Table 6

Counts by Race and Problem Set for the Pilot Test

Set	Whites	Blacks	Hispanics	Total
1-4	26	12	2	40
96-99	28	10	2	40
Total	54	22	4	80

The random selection of problem sets produced a very even split by race.

Next, we examined any difference between groups on final score. Since we had a fairly small sample, we combined Blacks and Hispanics into one total minority group. A one-way analysis of variance on final

score revealed a significant difference between the groups $F(1, 79) = 8.93$, $p < .01$. We then set about attempting to discover where the main difference occurred.

Table 7 shows the means for whites and minorities on each of the main sub-scores for each exercise (TEPS and YSC), as well as the significance of the differences.

Table 7

Means by Race on TEPS, YSC, and TOTSC

for Each Exercise in the Pilot Test

Variable	Whites	Minorities
Q1TEPS	9.010	8.384
Q2TEPS	9.287	6.557**
Q3TEPS	8.556	7.536
Q4TEPS	7.755	7.364
Q1YSC	8.488	8.173
Q2YSC	8.372	8.173
Q3YSC	7.569	7.260
Q4YSC	9.375	8.654*
Q1TOTSC	17.498	16.557
Q2TOTSC	17.659	14.730**
Q3TOTSC	16.125	14.795
Q4TOTSC	17.131	16.018
Final	68.412	62.101**

*$p < .05$. **$p < .01$.

As can be seen, the means on TEPS for exercise 2 were significantly different, as were the means on Q4YSC and Q2TOTSC. Exercise 2 was

either problem 3 or its parallel, 99. We further attempted to pin the problem down by conducting the same tests on each of the two problem sets. The data for the set numbered 1-4 are presented in Table 8. The data for set 96-99 are presented in Table 9.

Table 8

Means by Race on TEPS, YSC, and TOTSC for Problems 1-4

Variable	Whites	Minorities
Q1TEPS	8.776	8.657
Q2TEPS	9.417	6.204**
Q3TEPS	8.537	8.689
Q4TEPS	8.114	7.241
Q1YSC	8.494	8.110
Q2YSC	8.333	7.961
Q3YSC	7.596	7.232
Q4YSC	9.238	8.674
Q1TOTSC	17.270	16.767
Q2TOTSC	17.750	14.166**
Q3TOTSC	16.133	15.921
Q4TOTSC	17.352	15.914
Final	68.505	62.769

*$p < .05$. **$p < .01$.

Table 9

Means by Race on TEPS, YSC, and TOTSC for Problems 96-99

Variable	Whites	Minorities
Q1TEPS	9.228	8.066
Q2TEPS	9.166	6.969*
Q3TEPS	8.573	6.191*
Q4TEPS	7.422	7.507
Q1YSC	8.482	8.247
Q2YSC	8.408	8.420
Q3YSC	7.545	7.292
Q4YSC	9.503	8.631
Q1TOTSC	17.710	16.312
Q2TOTSC	17.574	15.389*
Q3TOTSC	16.118	13.482*
Q4TOTSC	16.925	16.138
Final	68.327	61.322*

*$p < .05$. **$p < .01$.

As can be seen, Q2TEPS shows significant differences for both problem sets. As a result, Q2TOTSC in both sets shows a significant difference. We theorized that this may have been due to the fact that this problem pair was the only one to use as a hose length a number which was not an even multiple of 100. Hose lengths in all other problems were an even multiple of 100. The only other TEPS which shows a difference is for exercise 3 in set 96-99. For the YSCs, there were no significant differences in either set. There was also a significant difference on Q3TEPS and Q3TOTSC in set 96-99.

Next, we constructed a rank-order list to determine if we would meet the 80% rule. We used a score of 60 as a passing point. At that score, we found the results presented in Table 10.

Table 10

Preliminary Passing Point for the Pilot Test

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	54	47	87.03	——
Minorities	26	14	53.84	61.86

Since we did not meet the 80% rule, we decided to try a new method to compute final scores. It appeared from the significance tests that most of the difficulty could be traced to exercise 2, or problems 3 and 99. Therefore, we computed a new final score by dropping these problems completely. We simply summed the scores on the other three exercises. This gave us basically a 67.5 point test instead of a 90. The overall means are presented in Table 11.

Table 11

Means by Race on TEPS, YSC, and TOTSC Without Problems 3 and 99

Variable	Whites	Minorities
Q1TEPS	9.010	8.384
Q3TEPS	8.556	7.536
Q4TEPS	7.552	7.364
Q1YSC	8.488	8.173
Q3YSC	7.569	7.260
Q4YSC	9.375	8.654*
Q1TOTSC	17.498	16.557

Table 11 (Continued)

Means by Race on TEPS, YSC, and TOTSC Without Problems 3 and 99

Variable	Whites	Minorities
Q3TOTSC	16.125	14.795
Q4TOTSC	17.131	16.018
Final	50.754	47.371*

*$p < .05$. **$p < .01$.

As can be seen, there is still a significant difference in final score. We then produced a new rank list and recalculated the passing ratios. We set the passing point this time at the point at which we would pass the same number of candidates (61) that passed in the previous method. This was done since we had no real a priori place to set the passing point on a 67.5 point test. The passing ratios are presented below in Table 12.

Table 12

Final Passing Ratios for the Pilot Test

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	54	45	83.33	----
Minorities	26	16	61.54	73.85

We still did not meet the 80% rule, but we did decrease the difference.

Next, we met with the Justice Department lawyer to discuss the results. Even though we did not meet the 80% rule, he did approve our use of the practical in the test for several reasons. First, we explained several changes we would make in the procedure and scoring from the pilot to the practical. One change would be to add more duties to

be checked off and added into the YSCs for each exercise. This could affect the results, since minorities did best compared to whites on the YSC portion of each exercise. Another change we planned was to accept a range of correct answers for the calculated pressure. Since any one of three methods was allowed, and we had no way of knowing which a candidate would use, we planned to change the scoring so that the entire range from the highest pressure of the three methods to the lowest was considered correct, not merely the average of the three. Another reason the lawyer approved it was that, due to reasons of security, the problems pilot tested here would not be used in the practical. Brand new problems would be written and we would not know how the results would look until we tried them. Also, the lawyer recognized that we were working with very small sample sizes here, and that we would have a much larger sample to analyze in the practical, which would give us a more reliable picture of a group's performance. For all those reasons, he approved the basic procedure used in the pilot for the practical.

CHAPTER VI

PRACTICAL TEST METHOD

Subjects

The subjects for the second part of the test, the practical, were all those who passed the written test. There were 617 candidates who passed the written and were thus eligible for the practical, and of these, 557 took the practical and 60 failed to appear. Of the 557 who took the practical, there were 410 whites, 112 Blacks, and 35 Hispanics.

Materials and Equipment

Materials and equipment for the practical portion were the same as those used in the pilot, with a few changes and exceptions. The answer sheet used for the practical was slightly different from the one used in the pilot. A copy of the one used in the practical appears in Appendix C. The changes in the answer sheet were made to record other duties besides those recorded in the pilot study. This was done as a result of converstaions with the Engineer Instructor after the pilot study had been completed. It was his opinion that additional duties should be checked for and the answer sheet was changed in order to record these.

The DOP staff at the practical were given Proctor Guides. The Guides contained instructions to the proctors regarding set up and procedure, and were slightly different from the Guides used in the pilot. A copy of the revised Guide for the practical appears in Appendix C.

The DOP staff also had the fingerprint cards which were filled out by the candidates at the time of the written test. This was in order to fingerprint the candidates again at the practical site. The purpose of this was to avoid any candidate sending a "ringer" to take his place at the practical.

Candidates for the practical were given a yellow grease pencil in order to write on the plastic case of the Hensel chart, or directly on the simulator's dials if they wished. They were also given a steno note pad to make calculations in and a Sharp Elsi-Mate EL-206 calculator.

The last pieces of equipment for the practical were two Panasonic 13" CT-1920-M color monitors, two JVC BR-6400 VHS video cassette recorders, two Scotch T-60 High Grade VHS video tapes, and two Superex headphones. On each tape was a 30 minute training film produced by the Fire Department on how to use the simulators. There was one film for each simulator. Prior to actually taking the practical, each candidate viewed the tape for the simulator he was about to use. The films covered such topics as how to read and set the dials, what all the knobs, dials, and controls were, safety measures, and general use of the simulator. A third room at the Fire Academy was used for this. The monitors were set up back to back so two candidates could use the room simultaneously, one for each tape. Candidates used the headphones while viewing the film so as not to disturb the candidate watching the other film. A copy of the script for the Hale training film appears in Appendix C. The film for the Waterous was essentially the same, just adapted to the different locations of the gauges on the Waterous simulator.

Procedure

Candidates for the practical portion of the test received letters with their score notices from the written test telling them to fill in the requested information and mail it to the Department of Personnel. The sheet asked them to fill in their platoon, work day, and furlough schedule, as well as their preference for type of simulator. A copy of this information sheet appears in Appendix C. This information was then used to schedule their appointments for the practical. Appointments were made by a DOP staff member. Candidates were then mailed a notice informing them of when and where to report for the practical. A copy of the practical Notice to Report appears in Appendix C.

Six candidates were scheduled per day on each simulator, for one hour periods. Candidates were scheduled at either 9, 10, or 11 a.m., and 1, 2, or 3 p.m.

When the candidates arrived at the Fire Academy, they were first brought into a room to view the training tape. This was proctored by a DOP staff member. There were two monitors back to back, two VCRs, and two sets of headphones. The candidates viewed the film for their respective simulators. At the conclusion of the film, they were fingerprinted in box 2 of the fingerprint card by the DOP member in that room. Then, one of the DOP staff proctoring the simulator the candidate was about to use brought the candidate from the film room to the simulator room.

For the practical, five sets of four problems each were used. None of the problems used in the pilot study were used again in the practical for reasons of security. The problems for the practical were

again drawn up by the Engineer Instructor. These problems, besides varying the length and diameter of the hose, and the type of nozzle, also varied the gallons per minute being pumped. This was either 1000 or 1250 gpm. None of these sets were intended to be parallel. That is, more than one variable differed among sets. The sets were numbered 1-4, 10-13, 21-24, 31-34, and 41-44. A set was chosen at random and used for approximately one week. This was done in order to randomly balance the number of candidates for each problem set across race and type of simulator. For the last few weeks of the practical, the problem set was changed daily, not weekly, in order to balance the numbers as closely as possible.

Again, at the beginning of each day, the Engineer Instructor made all the connections to set up the day's problem set. He checked to make sure all connections were proper. He also checked the connections at the end of the day to make sure all were operating properly and that nothing had come loose during the course of the day.

Each room had two DOP staff members. One primarily recorded the candidate's responses, times and behaviors, while the second verified the accuracy of the recordings. The proctor who did the recording was also the one who read the directions from the Proctor Guide to the candidates.

After the candidates entered the simulator room, the procedure was very similar to the procedure used in the pilot study. The DOP staff followed the Proctor Guide in Appendix C. Some slight changes in language were made, including adding new duties for the DOP staff to check for. Copies of the revised Proctor Guide and answer sheet are in

Appendix C.

Instructions in capital letters were read verbatim to the candidates. Candidates were read the first exercise, and their answer and response time were recorded. Candidates were then told to produce this pressure on a particular Discharge gate on the simulator. Their setting and time it took were recorded. Then, candidates were told to step back while the DOP staff checked the controls in order to check off the duties listed on the answer sheet. Candidates were then told to shut down the line as if returning to quarters. This procedure was repeated for the other three exercises with the exception of the third and fourth exercises. After the third exercise, candidates were not told to shut down the line. The fourth exercise given to the candidate was to be added on to the line already used for the third exercise. At the conclusion of the fourth exercise, the candidates were told to shut down the lines as if returning to quarters. The candidates were then dismissed.

After all candidates were tested, the answer sheets were returned to the DOP. There, the data were entered by our clerical staff. Once the final scoring method was decided upon, final scores were computed for all candidates. Score notices were then sent to all candidates. A copy of both the passing score notice and the failing score notice appear in Appendix C. How the final scoring method was decided upon will be discussed in the next section.

CHAPTER VII

PRACTICAL TEST RESULTS

Before calculating any scores from the practical, we first adjusted the formula to account for three things. First, by using 6 as a base number of points instead of 5, we came closer to a possible score of 100. Changing to 6 meant that the highest possible score on the practical was 98. Second, we adjusted the point values for each of the related duties to be checked off in order to account for the additional duties which were added. The total per exercise was still 12.5, so each individual item was worth less than in the pilot. Third, we now allowed a range as the correct answer to each problem. The range was from the lowest pressure of the three methods to the highest. As stated earlier, this was due to the fact that the candidates could use any one of the three methods to compute the pressure, and they would result in different answers to the same problem.

Before proceeding, we again checked the numbers of candidates who had each problem set to determine if the randomization of problem sets worked. The results are presented in Table 13.

Table 13

Counts by Race and Problem Set for the Practical Test

Set	Whites	Blacks	Hispanics	Total
1-4	77	24	9	110
10-13	83	22	7	112
21-24	91	19	3	113
31-34	79	24	7	110
41-44	80	23	9	112

Again, the randomization produced a very even split.

Next, we calculated scores for the candidates using the same basic formula as in the pilot, with the changes mentioned above. That is, each exercise was worth 25 points, 12.5 from setting and calculating, and 12.5 from the yes-no items. Of the 12.5 from setting and calculating, 55% was from calculating and 45% was from setting. Speed and accuracy were equally weighted. Candidates started with a base of 6 points. In calculating, they lost one for every 10 pounds, plus or minus, from either end of the range of correct answers, and one point for every 30 seconds it took. In setting, candidates again started with 6 and lost one for every 5 pounds, plus or minus, from the calculated answer, and one point for every 30 seconds it took to set. Each of the related duties were equally weighted within each exercise to form 12.5 points for each exercise. Using this procedure, scores were calculated for all candidates.

Based on this, and using as a proposed passing point the highest score at which we met the 80% rule for both Blacks and Hispanics, we found the results presented in Table 14.

Table 14

Preliminary Passing Ratios for the Practical Test

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	309	289	93.53	----
Blacks	92	69	75.00	80.19
Hispanics	31	31	100.00	106.92

It should be noted that the sample size at that point was 432, not the total 557 which would eventually take the practical. These analyses were conducted before all candidates had taken the practical in an effort to determine the scoring method as soon as possible so an eligible list could be posted as soon as possible.

The score at that point was 76.42. Even though we met the 80% rule here, we still had a major concern. This was that promotions to Engineer are not made often. At the proposed passing point, a total of 389, or 90.05%, passed. If this rate was extended to the entire group of 557, then 502 of the candidates would pass and be placed on the eligible list. However, it was not likely that all of them would be promoted before the next test was given. Therefore, the actual number who "passed" in the sense of being promoted would be much smaller, and the "passing" point much higher than 76.42 In addition, the farther we went up the list, the farther we came from meeting the 80% rule. In the final counts, Blacks were 20.1% of the practical test takers, and Hispanics were 6.3%. We wanted to approximate those percentages as closely as possible in the upper portions of the list.

Before we tried any options to alleviate this problem, a sugges-

tion was made by the Engineer Instructor regarding scoring policy. He informed us that there was a written rule in the Fire Department that Engineers were never to deliver more than 200 psi pressure unless on the direct order of the Lieutenant or Captain in charge. This is because more than this would make the line difficult to handle by the Firefighters, or may even cause the line to burst and create a serious safety problem. We did recognize this as a problem, as can be seen on the answer sheet. One of the duties to be checked off was whether the candidate exceeded 200 psi. If yes, then the candidate lost the points connected with that item. However, the Engineer Instructor felt that this was not enough. He felt that this was such a serious safety concern to both Firefighters and the public that a candidate should lose all 25 points for any problem in which the candidate exceeded 200 psi, either in the calculated answer to the problem, or at any time while setting the pressure on the simulator. This suggestion was discussed by officials of the DOP including the Deputy Commissioner, and it was decided to incorporate it into the scoring method. If a candidate either calculated an answer or produced a setting of over 200 pounds, the candidate would receive zero points for that exercise. After adding this to the scoring, scores for all candidates were recalculated. This yielded the results presented in Table 15.

Table 15

Passing Ratios for the Practical Test

Changing the Scoring to Lose All Points if 200 PSI Exceeded

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	309	284	91.91	----
Blacks	92	68	73.91	80.42
Hispanics	31	27	87.10	94.77

Again, the passing point was chosen as the highest score at which we met the 80% rule for both Blacks and Hispanics. This score was 46.66. As can be seen, however, there is not much difference between this method and the previous method. A total of 10 fewer candidates passed, but 422 would still pass at this point. In addition, we still had the problem of fewer minorities toward the top of the list. Therefore, we decided to adjust the scoring routine further.

It was decided to adjust the time bands from 30 seconds in setting and calculating, and to try different ranges in psi difference. It was suggested to try plus or minus 5, 10, or 15 psi in calculating and setting. Fifteen was the maximum since we did not want to allow full credit for an answer more than 15 psi from the answer since we were allowing a range of responses to be correct in the first place. We also felt that for full credit, candidates should be able to deliver within 15 psi at the most of what they intend. Therefore, we did not attempt any range of greater than 15 pounds. For speed, we adjusted the scoring to use bands of 10, 20, and 30 seconds. We did not want to allow full credit for more than 30 seconds in either calculating or setting

the pressure since at an actual fire scene, every second could be vital to saving lives, so 30 seconds was the maximum band we tried.

Scores for candidates were computed using all possible combinations of the time and pressure bands. We used 5, 10, and 15 psi bands in calculating and setting, and 10, 20, and 30 second bands in calculating and setting. In addition, we computed them all deleting all points on an exercise if the candidate exceeded 200 psi, and not deleting all points. This produced a 3 x 3 x 3 x 3 x 2 matrix, or 162 possible scoring methods, all of which were computed.

When the results were examined, there was no one method which produced a clear cut difference over the others. Most methods yielded results which were very similar to each other. However, after many discussions, one method was decided on as the best. In this method, candidates lost one point for every 15 psi plus or minus from either end of the range of correct answers in calculating, lost one for every 10 seconds necessary to compute the answer, lost one for every 5 psi plus or minus from the calculated answer in setting the pressure, lost one for every 30 seconds necessary to set the pressure, and lost all points for an exercise if they either calculated an answer or at any time went over 200 pounds when producing the pressure on the simulator. This produced the results presented in Table 16.

Table 16

Passing Ratios for the Practical Test

Using the Best of the 162 Scoring Methods

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	309	277	89.64	----
Blacks	92	66	71.74	80.03
Hispanics	31	26	83.87	93.56

The score at this passing point was 53.09.

As can be seen, this method gave us the fewest number of total candidates passing, which was 369. However, in the top 100 on the list, we were not close to meeting the 20.1 and 6.3 percentages of test-takers for Blacks and Hispanics, respectively. Therefore, we decided to try another approach.

Using the above method, we analyzed the data to see if we could determine what was causing the difference. We knew from the pilot test that length of hose appeared to have an impact. Therefore, we examined that here. Since none of the problems in the pilot were used in the practical, the Engineer Instructor had to write 20 new problems for the practical. Three of them, #13, 24, and 43, included hose lengths which were not an even multiple of one hundred. He included these because he said it was difficult to develop 20 questions which would be completely different otherwise. So, to see if this had an effect in the practical, a one-way analysis of variance was conducted on each of the 20 problems. Table 17 shows the problems which showed a significant difference on TOTSC.

Table 17

Problems Showing a Significant Difference on TOTSC

Problem	Whites Mean	Blacks Mean	Hispanics Mean
2	22.333	17.784	22.180**
3	20.206	12.998	15.777**
4	18.689	10.046	16.414**
11	19.631	10.821	18.754**
13	21.796	16.895	20.184*
33	22.069	17.461	19.399*
42	22.959	18.468	20.812*
44	19.913	15.600	14.703*

*$p < .05$. **$p < .01$.

As can be seen, of the three problems using a hose length which was not in a round hundred, only #13 showed a significant difference on TOTSC. Tables 18 and 19 show the results of one-way analyses of variance breaking each problem into its components of YSC and TEPS, respectively.

Table 18

Problems Showing a Significant Difference on YSC

Problem	Whites Mean	Blacks Mean	Hispanics Mean
2	11.699	10.938	11.719*
4	10.481	9.310	9.809**
10	11.785	11.044	11.272**
11	10.919	9.908	10.714**
13	11.817	11.189	12.225*
42	11.895	11.039	11.632**

*$p < .05$. **$p < .01$.

Table 19

Problems Showing a Significant Difference on TEPS

Problem	Whites Mean	Blacks Mean	Hispanics Mean
1	11.272	10.021	9.222**
3	11.604	10.985	9.828*
4	10.983	9.052	8.878**
10	11.920	10.534	11.314**
11	10.943	8.882	10.621**
13	12.083	10.973	11.086**
21	11.536	9.821	10.033**
24	10.827	9.268	10.567*
32	11.708	10.240	10.393**
34	10.926	9.660	10.143*
41	11.804	9.878	11.556**
44	10.875	9.415	10.122*

*$p < .05$. **$p < .01$.

As is shown, problem 13 showed a significant difference on both the YSC and TEPS components. Problem 24 did show a significant difference on TEPS, indicating that the odd hose length may be the cause. However, the difference was not great enough to cause problem 24 to have a significant difference on the TOTSC. Problem 43 did not show a significant difference on either component. These results are difficult to interpret. This would indicate that length of hose being an even multiple of 100 may or may not be a factor.

Since these results were far from conclusive, we decided to analyze other factors. Four variables were analyzed. These were the race of the candidates, the problem set, the type of simulator, and time on the job.

A four factor analysis of variance was conducted. The results are presented in Table 20. The four-way interaction was not significant. The only three-way interaction to show a significant effect was the interaction among type of simulator, time on the job, and race. None of the two-way interactions were significant, and neither was the main effect of time on the job. Since time on the job did not have an effect anywhere else in this table, and due to the fact that our sizes in each cell were getting extremely small in a three-way interaction, especially for Hispanics, we decided not to concentrate on time on the job in the remaining analyses. Therefore, we concentrated on type of simulator and race. Both main effects were significant. For simulator type, the means are presented in Table 21.

Table 20

Four Factor Analysis of Variance Table

Source	DF	Sum of Squares	F	p
Problem set	4	2217.8974	1.54	0.1882
Simulator	1	2578.0351	7.18	0.0076
Prob*Simulator	4	369.3228	0.26	0.9052
Time on job	4	1451.9997	1.01	0.4012
Prob*Time	13	7952.4956	1.70	0.0569
Simulator*Time	4	2176.4941	1.52	0.1965
Prob*Simulator*Time	10	3360.6798	0.94	0.4994
Race	2	14280.2369	19.89	0.0001
Prob*Race	8	5781.9288	2.01	0.0534
Simulator*Race	2	159.9436	0.22	0.8004
Prob*Simulator*Race	8	2564.1223	0.89	0.5222
Time*Race	7	2949.4098	1.17	0.3160
Prob*Time*Race	16	4809.1056	0.84	0.6429
Simulator*Time*Race	5	4905.4154	2.73	0.0191
Prob*Siml*Time*Race	7	2724.1511	1.08	0.3723
Error	448	160812.2381		
Total	543	219093.4760		

Table 21

Descriptive Statistics by Simulator

Simulator	Mean	N
Hale	71.308	320
Waterous	75.691	224

It should be noted here that the total sample size at this point was 554. At the time these analyses were conducted, more candidates had taken the practical portion, but there were still 13 candidates who had rescheduled their appointments and had not taken the test yet.

For race, the results are in Table 22.

Table 22

Descriptive Statistics by Race

Race	Mean	N
Whites	76.164	400
Blacks	63.439	110
Hispanics	68.512	34

The breakdown of simulator and race is in Table 23.

Table 23

Breakdown Table of Simulator by Race

	Simulator				
	Hale			Waterous	
Group	Mean	N	Group	Mean	N
Whites	74.462	239	Whites	78.691	161
Blacks	60.343	60	Blacks	67.153	50
Hispanics	66.740	21	Hispanics	71.374	13

The interaction was not significant, as seen in Table 20. Since the interaction was not significant but both main effects were significant, this indicated that the differences among races were not affected by type of simulator, and vice versa. Based on these findings, we decided to standardize scores on the basis of race and simulator.

Before standardizing, we discussed our findings to this point with the Justice Department. The lawyer approved everything we had done so far, and agreed that the next step would be standardization. Again, as in the written test, we had two options open to us. The first was to standardize each of the three race groups on the Hale simulator to the overall mean and standard deviation of all candidates on the Waterous simulator. The second was to standardize the three groups on the Hale

to the means and standard deviations of their own race groups on the Waterous simulator. Since we did not want to duplicate the problem created when we standardized the written test scores, we decided to use the second method and standardize whites on the Hale to the mean and standard deviation of whites on the Waterous, Blacks to Blacks, and Hispanics to Hispanics.

By this point in time, the 13 candidates who rescheduled their appointments had taken the practical, so we had our final total of 557 candidates. Before calculating final means and standard deviations by race on the Waterous simulator, it was decided to delete any candidate who received a zero on at least three of the four exercises due to exceeding 200 pounds. We felt that these candidates were outliers and would significantly lower the means. Therefore, means and standard deviations for the groups on the Waterous were computed deleting any candidate with a score of 25 or lower. The resulting means and standard deviations are in Table 24.

Table 24

Descriptive Statistics by Race on the Waterous Simulator

Deleting Candidates with a Score of 25 or Below

Group	Mean	S.D.
Whites	86.7278	14.7080
Blacks	82.0121	17.6076
Hispanics	77.9390	18.2512

Each of the three groups on the Hale were then standardized to their respective distributions from the Waterous. We then constructed a rank-order list based on these scores. Upon examination of the list, we

found that the first nine candidates on the list were all minorities, with eight Blacks and one Hispanic. Our Deputy Commissioner felt that we had improved minorities' scores too much and that if we showed these results to the Fire Department the Union would suspect tampering and sue us to delay posting of the list. We did not want that because the Commissioner of the Fire Department had been pressuring us to post a new list as soon as possible so promotions could be made. Having promotions delayed because we went to court was not in the best interests of anyone. The Fire Department needed more Engineers and the public had a right to this protection. Faced with this situation, our Deputy Commissioner suggested we add a new twist to the scoring. It was suggested that instead of a base of 6 points in calculating and setting the pressure, we start with 7 points. This meant that the highest possible score was now 106. Then, all scores greater than 100 would be rounded to 100, and ties would be broken by seniority. Our Deputy Commissioner felt that this would give us enough representation of minorities at the top, but they would be more distributed due to breaking ties by seniority. Therefore, we created new scores adding this to the scoring, and established a new rank-order list. In this new list, 56 candidates were tied at 100, and had the ties broken by seniority. In this top 56, the counts by race are in Table 25.

Table 25

Counts and Percentages by Race of Candidates in the Top 56

Group	Count	% in Top	% of Takers
Whites	39	69.64	73.6
Blacks	12	21.43	20.1
Hispanics	5	8.93	6.3

As can be seen, these percentages are very close to the percentages of the practical test takers. We set the new passing point at 70, due to the fact that we raised the possible scores by increasing the base points from 6 to 7. At this point, we found the passing ratios presented in Table 26.

Table 26

Passing Ratios for the Practical Test Using the Final Scoring Method

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	410	345	84.15	——
Blacks	112	80	71.43	84.88
Hispanics	35	23	65.71	78.09
Total	557	448	80.43	

As can be seen, we met the 80% rule for Blacks, but were just short for Hispanics. This did serve to redistribute the Blacks at the extreme top of the list as well.

One last step needed to be taken. The announcement stated that final scores would be composed of 90% scores on the practical and 10% seniority. We had used a seniority component in many prior exams. The method for computing points was to begin with a base of 70. Then, for

every month of service, candidates received one point, up to a maximum of 100. In this case, it had been more than two and one-half years since new Firefighters were hired, so all candidates achieved the maximum 100. For final scores, we multiplied their practical scores by .9, and added 10 points for seniority. The final passing ratios are listed in Table 27.

Table 27

Passing Ratios for the Practical Test Including a Seniority Component

Group	Number Taking	Number Passing	Pass Rate	% White Rate
Whites	410	357	87.07	——
Blacks	112	85	75.89	87.16
Hispanics	35	26	74.29	85.32
Total	557	468	84.02	

As can be seen, this resulted in an additional 20 candidates passing, and we now met the 80% rule for both Blacks and Hispanics. In addition, the top 56 remained as it was, resembling the percentages of the test takers. We discussed the results with the Justice Department. The lawyer approved them, the eligible list with these scores was posted, and score notices were sent to all candidates.

CHAPTER VIII

DISCUSSION

This paper dealt with the development and implementation of a testing instrument to promote candidates to the rank of Fire Engineer. It was stated at the beginning that this instrument must meet two goals. It must be job-related, and it must meet the Uniform Guidelines regarding personnel selection. The first goal was met by having input throughout the procedure from the Engineer Instructor of the Fire Department, and by performing an update on the job analysis for the position. The second goal was met by having input from the Justice Department and by some creative scoring methods. While the scoring may have seemed confusing and convoluted, everything we did was done for a reason. It must be remembered that this test was not conducted on disinterested subjects for pure research. Instead, it used candidates who had a vested interest in the outcome, and in a setting with conflicting pressures. We wanted at all times to be as fair as possible to all concerned. We wanted to improve minorities chances of being promoted, but not to improve so much so as to adversely affect whites' chances of being promoted. That is a very fine line to walk, and, if possible, we wanted to walk it without going to court in order to post the list and make promotions as quickly as possible. This was made even more difficult at the time since the Federal Government was at that time suing to

have prior quotas removed in some cities. So, even though the mood of the national administration was one of resistance to affirmative action, the lawyer from the Justice Department working on this case with us was very much in favor of affirmative action. It made for a very confusing set of priorities.

Another real consideration was explaining the scoring to the candidates and to the powerful Fire Union. After the scoring method was worked out and candidates received their scores, they did have the right to ask about the scoring method. Also, the union would want to know how it was scored. Recall, it was primarily due to their pressure that the six dropped items on the written test were allowed to be counted towards a raw score of 60 to pass. If the union leaders, who were primarily white, did not like the scoring, they would have sought an injunction preventing us from making promotions from this list. This has happened on previous exams. As stated, we did not want this, but we did have to take this into consideration when making decisions regarding scoring methods.

The results of the written test were not surprising. Our written tests generally show adverse impact against minorities, even tests for entry level positions which are nothing more than reading comprehension tests. Therefore, the adverse impact here was not totally unexpected, especially since there was adverse impact on this test in 1978. Since this was the case, it was appropriate that the written test was used on a pass-fail basis. In that way, it did not contribute any possible adverse impact towards final scores. We only had to be concerned with passing ratios at the cutoff point. If, as in the previous test, the

scores from the written test were used as part of the final scores, then we would have had to make sure that minorities were well represented throughout the list, as we did with the practical test.

The results of the practical pilot test were encouraging. It appeared as though we had located the cause of the significant difference between whites and minorities as being a specific problem pair which had the feature of a hose length not in a round hundred figure. However, the results of the practical did not reveal a significant difference due to problem set. If one particular problem did produce different results among the groups, it was not great enough to show for the entire set. However, while the problem sets did not have an effect on scores, race and type of simulator did, which resulted in adverse impact against minorities. Therefore, we were not able to produce minorities towards the top of the list until we standardized scores. While we know that written tests generally show adverse impact against minorities, we had hoped that this hands-on test of ability would be free from that problem. This was not the case. One possible explanation for this may be motivation of the candidates. Since this test did represent a possible career advancement for the candidates, theoretically they all should have been highly motivated to perform well. However, I do not believe this was the case. First, approximately, 270 candidates who applied for the exam did not even show up for the written test. Second, of the 617 eligible to take the practical, another 60 failed to appear. One may think, then, that the 557 who did take the practical were the most highly motivated. But again, this was not necessarily so. Several candidates stated afterwards that they did not really try or want the

promotion, they just took the test to see what it was like. Unfortunately, this is something we cannot control for. We cannot stop anyone who is eligible from taking the test, and, on the other hand, once a candidate applies, we can do nothing to ensure that he actually takes the test.

More evidence of the motivation factor is that after the test, we learned that many candidates practiced on their own on actual engines prior to their appointment. This can be taken as evidence that those candidates were highly motivated. However, we do not know who practiced and who did not. Therefore, we can not attempt to determine if that was in part responsible for the results. Also, we would not be able to control this aspect. That is, we could not stop anyone who wished to practice from doing so, and, conversely, we could not force anyone to practice.

A corollary of the motivation to practice factor would be that those candidates who practiced would also be more familiar with the controls than those who did not. For many candidates, the practical was probably the first time they actually tried to pump water. However, having used the simulators once may help to alleviate any problem of unfamiliarity for the next test.

Another factor which may have had an effect was the method candidates used to calculate the pressure. Candidates were free to use whichever method they wished, and we did not know which one they chose. They may not even have limited themselves to one. They may have tried two or all three and taken an average. There are two things which can be done about this for the next test. One would be to tell candidates

that they may only use one particular method for computing pressure. Then we would only have one correct answer per problem, not three. A second option would be to allow them to use any of the three, and after they answer the problem, ask the candidate which method was used to calculate, and record it on the answer sheet. Then, their answer would be compared to the pressure for this problem as computed by that method. I believe that this would give us a much truer picture of ability than using the ranges we had for this test. Within the ranges, candidates may well have simply guessed and been in the range of acceptable answers. I believe this needs to be changed to one of the two previous suggestions.

I now want to review some specific problems with our procedures and analyses and make recommendations for their improvement. First, for the next test, I would recommend that a complete formal job analysis be conducted. The update conducted for this exam was very informal. That is, lists of the tasks and knowledges, skills, and abilities generated by the 1978 job analysis were given to several members of the Fire Department for their review. They merely indicated whether they felt those tasks and KSAs were still relevant to the job of Fire Engineer. I believe that for the next test we should start completely from scratch. We should have a panel of incumbents generate a new list of tasks, then have those tasks rated to determine which are the most crucial. Next, generate KSAs from these crucial tasks, and then rate the KSAs to determine which of those are the most crucial. The test will then reflect the crucial KSAs. This would be a more formal and documented procedure than what was done this time. It would also make a stronger argument

for the content validity of the test.

The next specific problem involves the way the results of the written test item analysis were used. Six items were dropped because fewer than 30% of the total group answered them correctly. This decision was made primarily by our Deputy Commissioner, and was based on a book on statistics for tests published by Educational Testing Service in which it says that items with fewer than 30% answering correctly should be dropped. This was not by itself a bad decision, however other factors should have been considered. Not counting the six already dropped, there were 12 items which displayed a point biserial for the total group of less than .2, and three of these displayed a point biserial of less than .1. This would indicate that these items are not strong predictors of success on the test and should have been dropped.

In addition, we did not examine the point biserials for each racial group. Without this, we do not know if any individual items impacted minorities adversely. If an item's point biserial for either minority group was significantly lower than it was for whites, then that item should have been dropped as well.

The next problem involves the calculation of the score. After standardized scores were computed, the decision was made to allow candidates credit for any of the six dropped items they answered correctly. As stated earlier, this primarily benefitted whites. At that point, we should have recalculated the means and standard deviations for the three groups, and then recomputed the standardized scores based on these new distributions. This was necessary due to the fact that whites did significantly better on these six items than did minorities, so adding them

back in but not recalculating the means still adversely affected minorities. The main problem in doing that, however, was that we had already sent out score notices to candidates before it was decided to count the six dropped items. The Fire Department, recall, was pressuring us to move as quickly as possible, on top of everything else, in order to post a list quickly. If we recalculated all the scores, we would have had to send new score notices, and this would surely have led to candidates questioning our ability to administer a test. In the ideal situation, we would have had enough time to thoroughly analyze the results before sending out score notices. In that way, we could have added the six items back and calculated new scores, and then sent the score notices.

As far as the scoring procedure of the practical portion goes, it would have been better from a purely statistical point of view to have had only one scoring method rather than 162. The more significance tests that are conducted, the greater the likelihood of finding a significant difference due to chance. The main reason 162 methods were tried was to increase the representation of minorities at the upper end of the list. Ideally, we should have decided on one method before calculating scores and stayed with that. Ironically, computing 162 different scores did not help us very much in that there was not much to choose among the methods, and we standardized for race and simulator differences after that anyway.

We also had a problem in the way the standardization for the practical was conducted. A significant main effect was found for type of simulator. This test was conducted using all the candidates. However, when we actually standardized, we first removed all the candidates

on the Waterous who had a score of 25 or lower before computing the means and standard deviations on the Waterous groups to which the Hale groups were standardized. This meant that the means for the racial groups on the Waterous were being raised, and that the racial groups on the Hale were being standardized to much higher scores. We should have done one of two things. The first would have been to standardize to the means and standard deviations using all the candidates. The other would have been to delete all candidates from both simulators who scored at 25 or below and then conduct a significance test on type of simulator with the remaining candidates. Doing what we did raised the Hale scores to a higher point than they should have been.

A last problem which needs to be pointed out is the fact that the seniority component actually constituted much less than 10% of the final score, even though it was intended to be 10%. This is due to the fact that, the way seniority was computed, all candidates received exactly the same score on the seniority component, which was a score of 100. Therefore, there was no variance in the scores in this component. So, instead of constituting 10%, it was actually a much smaller part of the final score. The best way to alleviate this problem for the next test would be to not include seniority as a component of the final score. It did have some impact on standing since it was used to break ties on the practical scores for the top 56. The seniority for that was in terms of time of service, so since most candidates were hired on different dates, the problem of equal seniority dates is not a factor. However, for the next test, the seniority component should be removed from the final score if the same situation occurs where it has been more than two and

one-half years since the last Firefighters were hired.

Despite these problems, we did manage to post an eligible list. The main factor in our favor was that the Justice Department lawyer was observing and approving every step we took. In this way, we helped to short circuit any problems we would normally have faced at the end of the test. If the Justice Department had not been involved, we may have stopped after one or two methods on the practical since at the passing point we met the 80% rule for minorities. We would have met the bottom line. However, the Justice Department would then have sued us on the grounds that minorities were underrepresented at the top of the list and that the first class of promotions would have had no minorities. In that case, we would have gone to court, which would have taken months, and the result would have been one of two things. One would have been, as in the case of the last test, the court would have imposed quotas on us for each class of promotions. The second would have been to do what we did anyway to find a scoring method suitable to everyone. By having the Justice Department's input from the start, we undoubtedly saved a great deal of time, money, and effort.

The end result was we developed a testing instrument for promotions to Engineer, and we were able to use a scoring method which produced satisfactory results. Promotions have been, and will be, made from this eligible list. Since this was the first time a test such as this had been used, the results are laudable. However, I think the suggestions made earlier for future tests will make the method even stronger, and may set the standard for other jurisdictions in their promotional tests.

REFERENCES

Alvares, K. M., & DeRosa, D. V. (1979). Report on validation of Fire Engineer's promotional examination. Unpublished manuscript, Bowling Green State University, Bowling Green.

Thompson, D. E., & Thompson, T. A. (1982). Court standards for job analysis in test validation. Personnel Psychology, 35, 865-873.

U.S. Equal Employment Opportunity Commission, U.S. Civil Service Commission, U.S. Department of Labor, & U.S. Department of Justice (1978). Adoption by four agencies of uniform guidelines on employee selection procedures. Federal Register, 43, 38290-38315.

APPENDIX A

WRITTEN TEST MATERIALS

NOTICE TO REPORT

DEPARTMENT OF PERSONNEL

DATE: JANUARY 19, 1985

EXAMINATION: FIRE ENGINEER

PLACE:

TIME: 9:00 A.M. SHARP

REPORT TO ROOM:_____

Any necessary scratch paper will be furnished by the Department of Personnel. No books, notes, or papers are permitted.

NOTE: BECAUSE WE CANNOT BE RESPONSIBLE FOR THEIR SAFETY AND WELFARE, CHILDREN, RELATIVES, AND/OR FRIENDS OF CANDIDATES WILL NOT BE ALLOWED AT THE EXAMINATION SITE DURING TESTING.

You may bring a pocket calculator to the examination if you have one. However, a pocket calculator will not be necessary to complete the examination. A pocket calculator will not be furnished by the Department of Personnel. The Department of Personnel assumes no responsibility for providing electrical outlets, recharging facilities or batteries.

Bring several sharpened #2 pencils and a record of your Social Security number with you to the examination site.

Bring this NOTICE TO REPORT with you to the examination.

BY ORDER OF THE DEPARTMENT:

COMMISSIONER OF PERSONNEL

DO NOT WRITE BELOW DOUBLE LINE

I hereby certify that I have received a test booklet bearing the Serial Number _____. I understand that failure to return this booklet at the conclusion of the examination will subject me to disqualification.

_____

Candidate's Signature

SIDE ONE

NAME

FOR USE [redacted] NCS SENTRY OPTICAL MARK READER EXCEPT THE SENTRY 7000

FOR PROCESSING BY NATIONAL COMPUTER SYSTEMS 4401 West 76th St., Minneapolis, Minn.

EXAMPLE

1 WRONG
2 WRONG
3 WRONG
4 RIGHT

IMPORTANT DIRECTIONS FOR MARKING ANSWERS

Use black lead pencil only (#2 or softer)
Make heavy black marks that fill the circle completely.
Erase clearly any answer you wish to change.
Make no stray marks on this answer sheet.

— REFER TO THESE EXAMPLES BEFORE STARTING PRACTICE EXERCISES —

PRACTICE

	A	B	C	D	E
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3					
4					

	A	B	C	D	E
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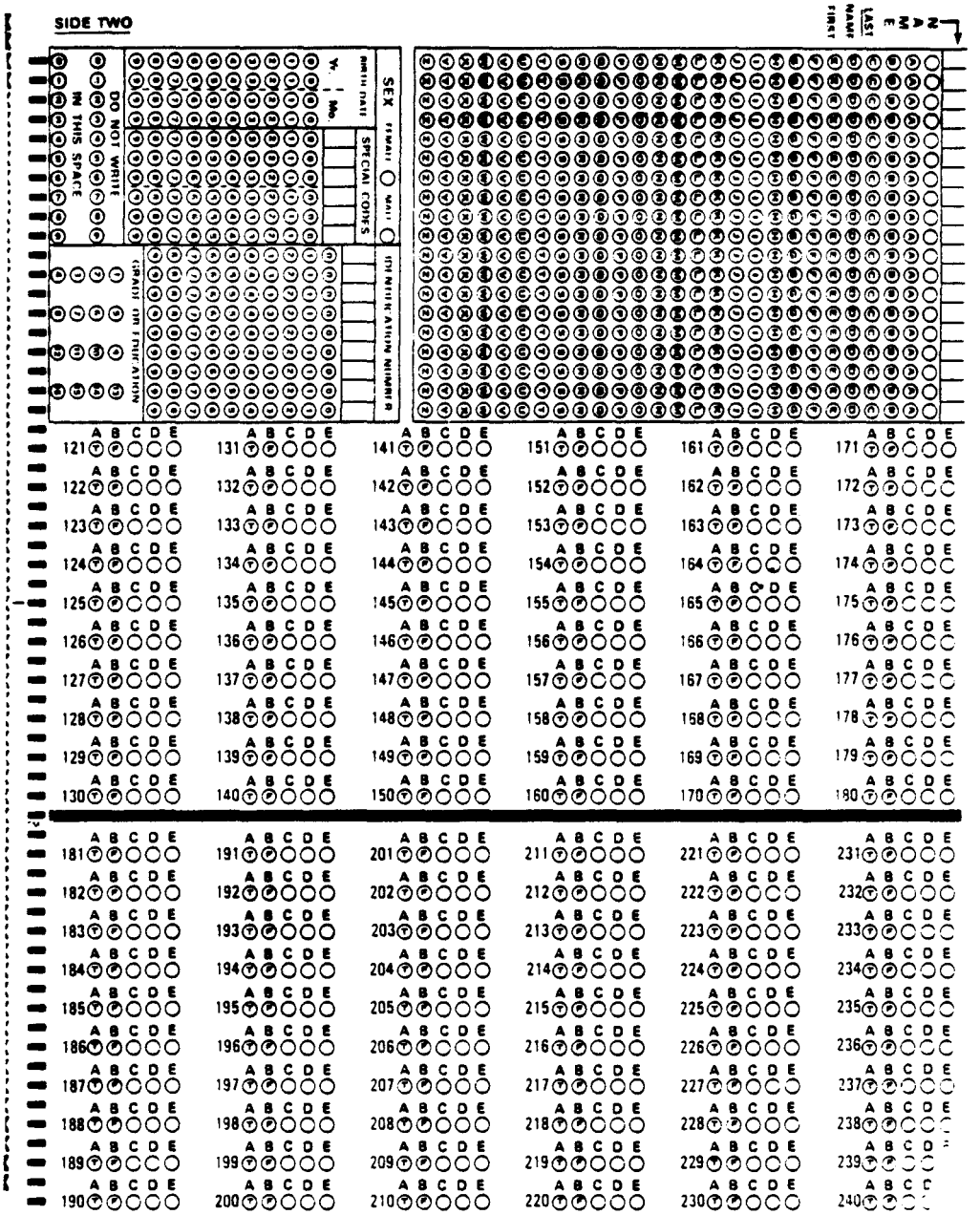
SIDE TWO
NAME
LAST NAME
FIRST
SEX
FEMALE
MALE
SPECIAL CODES
DO NOT WRITE IN THIS SPACE
A B C D E

CITY OF

Fingerprint Card

NAME _____ ADDRESS _____
(print) Last First Middle

Zip _____

EXAMINATION _____ Social Security Number _____

Your Age _____ Height _____ Weight _____ Sex _____ Eyes _____ Hair _____

Race/Ethnic Identification: (The following definitions are those currently used by the United States Equal Opportunity Commission. This information will be used for statistical purposes only.)

☐ White ☐ Black ☐ Hispanic
☐ American Indian ☐ Asian American ☐ Other

1	2	3
_____ date	_____ date	_____ date
_____ Your Signature	_____ Your Signature	_____ Your Signature

IS LR508

Dear Proctor:

The Department of Personnel will be holding a Fire Engineer examination on Saturday, January 19, 1985 at High School. Please enter through Auditorium entrance on the northeast corner of the building. Once inside report to the office for assignment.

The time to report is 7:30 A.M. SHARP. Please do not be late. There will be only one administration of this test. You will be paid a flat fee of $35.00 for this A.M. session.

If you wish to accept this assignment, you must telephone at no later than Wednesday, January 16, 1985, 4:00 P.M. Please bring this letter with you to the school as identification as a proctor.

Sincerely,

Deputy Commissioner
of Personnel

PROCTOR GUIDE

FIRE ENGINEER

1. Place a fingerprint card and Answer Sheet at each candidate's desk. On the blackboard write:

School:	HIGH SCHOOL
Date:	JANUARY 19, 1985
Exam:	FIRE ENGINEER
Room:	Your Room Number

For identification by name and Social Security number, write the following samples on the blackboard:

NAME				IDENTIFICATION NUMBER						SPECIAL CODES					
			Etc.						Etc.						
A	A	A	A	0	0	0	0	0	0	0	0	0	0	0	0
B	B	B	B	1	1	1	1	1	1	1	1	1	1	1	1
C	C	C	C	2	2	2	2	2	2	2	2	2	2	2	2
Etc.				Etc.	3	3	3	3	3	Etc.	3	3	3	3	3

2. Allow a candidate to enter only after having checked the candidate's Notice to Report. If it is missing direct him/her to the School Office.

3. THE FOLLOWING RULES ARE TO BE OBSERVED DURING THE EXAMINATION:

   (a) YOU ARE NOT TO COMMUNICATE WITH ANY OTHER CANDIDATE. IF YOU HAVE A QUESTION, RAISE YOUR HAND.

   (b) NO SMOKING IS ALLOWED IN THIS SCHOOL.

   (c) FOR SCRATCH PAPER, USE ANY SPACE YOU WISH IN THE TEST BOOKLET. YOU MAY NOT USE YOUR OWN SCRATCH PAPER.

   (d) ALL TEST MATERIALS MUST BE RETURNED. FAILURE TO DO SO WILL SUBJECT YOU TO DISQUALIFICATION.

   (e) ALL MATERIALS MUST BE REMOVED FROM YOUR DESK EXCEPT THE FORMS PROVIDED BY THE DEPARTMENT OF PERSONNEL.

4. YOU WILL NOW FILL OUT THE FORMS ON YOUR DESK. (The PIC is to hold up an example of each card as he/she directs the candidates to fill it out.)

(a) TAKE YOUR FINGERPRINT CARD AND PRINT THE INFORMATION REQUESTED. WRITE TODAY'S DATE AND YOUR SIGNATURE IN SECTION #1.

(b) TAKE ALL OTHER MATERIALS OFF YOUR DESK. YOU WILL NOT NEED THEM DURING THE EXAMINATION.

(c) ON SIDE TWO OF YOUR ANSWER SHEET FILL IN YOUR NAME, LAST NAME FIRST, IN NUMBER 2 PENCIL. USE A NUMBER 2 PENCIL ONLY. PUT ONE LETTER IN EACH BOX STARTING AT THE LEFT. Refer to example on blackboard. LEAVE A SPACE BETWEEN YOUR LAST AND FIRST NAME. YOU MAY PUT YOUR MIDDLE INITIAL IN IF SPACE ALLOWS. IF THERE IS NOT ENOUGH SPACE FOR YOUR ENTIRE NAME, FILL IN AS MUCH AS POSSIBLE. IF YOU HAVE A QUESTION, RAISE YOUR HAND. IN THE COLUMN BELOW EACH LETTER FILL IN THE CIRCLE THAT CORRESPONDS TO THAT LETTER. Again refer to example on blackboard using C as an example. WHERE THERE IS A BLANK SPACE BETWEEN YOUR LAST AND FIRST NAME, FILL IN A BLANK CIRCLE LOCATED IN THE FIRST ROW. IF YOU HAVE ANY QUESTIONS, RAISE YOUR HAND.

(d) IN THE BOX MARKED SPECIAL CODES, USING THE LAST THREE BOXES TO YOUR RIGHT, WRITE YOUR ROOM NUMBER. Refer to example on blackboard. PLACE ONE NUMBER IN EACH BOX. IN THE COLUMN UNDER EACH NUMBER FILL IN THE CIRCLE THAT CORRESPONDS TO THAT NUMBER.

(e) IN THE BOX MARKED IDENTIFICATION NUMBER, WRITE YOUR SOCIAL SECURITY NUMBER IN THE BLANK BOXES STARTING AT THE LEFT. PLACE ONE DIGIT IN EACH BOX. IN THE COLUMN UNDER EACH NUMBER FILL IN THE CIRCLE THAT CORRESPONDS TO THAT NUMBER. Refer to example on the blackboard. IGNORE THE OTHER BOXES. IF YOU HAVE ANY QUESTIONS, RAISE YOUR HAND.

(f) WRITE FIRE ENGINEER NEXT TO THE WORDS "SIDE TWO." YOUR WRITING MUST NOT TOUCH EITHER OF THE GREEN BOXES BELOW THE WORDS "SIDE TWO."

(g) ON SIDE ONE OF YOUR ANSWER SHEET, SIGN YOUR NAME AT THE TOP OF THE SHEET WHERE IT SAYS "NAME." YOUR SIGNATURE MUST NOT EXTEND BELOW THE GREEN LINE PROVIDED FOR "NAME."

5. WHEN I GIVE YOU YOUR EXAMINATION BOOKLET, YOU ARE TO RECORD YOUR BOOKLET NUMBER AND SIGN YOUR NAME ON THE BOTTOM OF YOUR NOTICE TO REPORT. Hold up a Notice to Report and show where they should sign. THIS ACKNOWLEDGES THE RECEIPT OF YOUR BOOKLET. DO NOT OPEN THE BOOKLET. The Proctor-in-Charge hands out the booklets, one to each candidate. When the Proctor-in-Charge has completed handing out the booklets, he/she may immediately begin Step 6. While the Proctor-in-Charge passes out the booklets, the Assistant Proctor should pick up all Notices to Report checking for the

signature. If everything is in order, the Assistant Proctor places the papers on the Proctor's-in-Charge desk. If something is not in order, he/she is to take the necessary action. For example, if the signature is missing, go back to the candidate and have him/her sign.

6. TAKE YOUR EXAMINATION BOOKLET AND READ THE INSTRUCTIONS TO YOURSELF AS I READ THEM ALOUD. Read the instructions on the cover and back of an extra test booklet and answer any questions. COUNT THE PAGES IN YOUR TEST BOOKLET TO SEE THAT IT IS COMPLETE. Replace any incomplete booklets. THE TIME IS NOW _____. YOU WILL HAVE 3 HOURS TO WORK ON THIS EXAMINATION. THE EXAMINATION WILL END AT _____. BEGIN!

7. Take a room count. On the blackboard write:

   Time Start:_____
   Time End:_____
   Room Count:_____

8. (a) Check to see that Answer Sheets are being filled out correctly. Proctors must check that the candidates are answering items down columns as described on the back page of the examination booklet. These answer sheets must be filled out in #2 pencil. Stop any candidate using ink.

   (b) Alphabetize the Notices to Report.

9. At the end of 3 hours say, "STOP, PUT YOUR PENCILS DOWN."

10. When each candidate checks out:

    (a) Count pages in the examination booklet.

    (b) If the examination booklet is complete, initial the Booklet Receipt Form beside the corresponding booklet number.

    (c) Check the candidate's answer sheet. Be sure that the Social Security number is correct. There must be only one circle blackened for each number. There must be no stray marks. The sheet must not be folded or wrinkled. Check the Social Security number against the Fingerprint Card. Alphabetize answer sheets.

    (d) Check the candidate's fingerprint card for completeness and accuracy. Instruct the candidate to report immediately to the fingerprint station.

11. Band Notices to Report. Put unmarked Answer Sheets in the kit.

12. Place marked alphabetized Answer Sheets in the folder and then

inside the large brown envelope. Be careful not to fold or damage the Answer Sheets.

13. Put Test Booklets in numerical order and place Booklet Receipt Form on top of the stack.

14. Bring materials to Central Office and return materials to Department of Personnel staff members who are handling the Check-out process.

EXAMINATION RULES

The Department of Personnel expects you, as a Proctor, to observe the following rules:

1. Test materials are never to be left unattended.

2. Booklets and/or test materials are never to be placed in desk drawers. All materials are to be turned in at the conclusion of the examination.

3. Candidates are to be told the length of the examination and the starting and ending times. Starting and ending times are to be written on the board.

4. During the examination the PIC and AP should circulate about the room. Check to be sure that candidates are completing the Answer Sheet correctly.

5. Reading of books, newspapers, magazines, etc. is not permitted during the test administration. Reading the contents of the test booklet is not permitted. Your full attention is to be directed toward the test administration.

6. Candidates are not permitted to leave the testing room alone after the start of the examination. Candidates must be accompanied to the washroom by a Proctor. Tell candidates to use the washroom before entering the testing room.

7. After the examination begins, take a room count and write the information on the board.

8. After the examination ends, put the test booklets in numerical order. Alphabetize the Answer Sheets.

9. Used Answer Sheets are put in the folder and inside the large brown envelope. All unused materials are to be put in the kit.

10. Direct candidates to report to the fingerprint station immediately.

11. If any problems arise, notify the Hall Proctor. He/she will take any appropriate action.

12. Follow the proctor guide exactly to ensure a correct and uniform test administration.

PROCTOR STATEMENT OF UNDERSTANDING OF EXAMINATION SECURITY POLICIES AND PROCEDURES

I understand that my duties as a Proctor require that I maintain the security and confidentiality of all examination materials and information that are entrusted to me.

I understand that I am never to leave any examination materials unattended. I understand that this includes forms used in the administration of examinations.

I understand that all materials must be accounted for and returned to Examination Division staff as soon as possible after the completion of an examination.

I understand that I am not to discuss or impart any information concerning an examination with anyone except an authorized individual.

I understand the consequences of breaches of security as described in Section 25.1-9E of the Municipal Code, which states:

Section 25.1-9E: "Any person who wilfully violates this section shall be fined not less than $100 nor more than $500 or be imprisoned for not more than six months, or both. Any person who is convicted of a violation of this section shall, for a period of five years, be ineligible for appointment to or employment in a position in the city service, and if he is an officer or employee of the city shall forfeit his office or position."

Signed _____

Address _____

Date _____

CITY OF
PROCTOR ASSIGNMENT CARD

EXAM: FIRE ENGINEER #40001 DATE:01/19/85
SCHOOL: HIGH SCHOOL

NAME:

ROOM ASSIGNMENT: _____ ____PIC ____AP ____HALL

BRIEFING ROOM: AUDITORIUM

PLEASE RETURN THIS CARD TO THE OFFICE AT THE COMPLETION OF THE EXAM.
NOTE ANY CHANGES OF NAME, ADDRESS, ZIP, OR PHONE # ON THIS FORM.

Adj. Fog 1½"
100 P.S.I. N.P. Plus 15 P.S.I. 50' Length of 1½"

3/4" S.O.P.
50 P.S.I. N.P. 118 G.P.M.

1½" S.O.P.
50 P.S.I. N.P. 328 G.P.M.

80 P.S.I. N.P. 415 G.P.M.

DISTRIBUTING NOZZLE
70 P.S.I. N.P. 386 G.P.M.
Friction Loss = 17 P.S.I. Per 50' - 2½"

7 P.S.I. Per 50' - 3"

3 P.S.I. Per 50' - 3½"

1½" P.S.I. 50' - 4"

3 P.S.I. Per 50' 2½" & 3" Siamesed

2½" Fixed For "Bell"
140 P.S.I. N.P. 455 G.P.M.
Friction Loss = 9 P.S.I. Per 50' - 3"

4 P.S.I. Per 50' - 3½"

2 P.S.I. Per 50' - 4"

4 P.S.I. Per 50' - 2½" & 3" Siamesed

Improvised Syphon
70-90 P.S.I. N.P.
Friction Loss = 18 P.S.I. Per 50' - 2½"

7 P.S.I. Per 50' - 3"

SCALE #1

FEET	3"	1-2 1/2" 1-3"	2-2 1/2"	1-3 1/2"
50	20	9.7	13.8	8.6
100	40	19.4	27.7	17.2
150	60	29.1	41.6	25.8
200	80	38.8	55.5	34.4
250	100	48.6	69.4	43.1
300	120	58.3	83.3	51.7
350	140	68.0	97.2	60.3
400	160	77.7	111.1	68.9
450	180	87.4	125.0	77.5
500	200	97.2	138.8	86.2
550	220	106.9	152.7	94.8
600	240	116.6	166.6	103.4
650	260	126.3	180.5	112.0
700	280	136.0	194.4	120.6
750	300	145.8	208.3	129.3
800	320	155.5	222.2	137.4
850	340	169.2	236.1	146.5
900	360	174.9	250.0	155.1
950	380	184.6	263.8	163.7
1000	400	194.4	277.7	172.4
1050	420	204.1	291.6	181.0
1100	440	213.8	305.5	189.6
1150	460	223.5	319.4	198.2
1200	480	233.2	333.3	206.9
1250	500	243.0	347.2	215.5
1300	520	252.7	361.1	224.1
1350	540	262.4	375.0	232.7
1400	560	272.1	388.8	241.3

SCALE #3

FEET	4-3"	4-2 1/2"	3-3"	3-2 1/2"
50	1.5	4.0	2.4	6.4
100	3.1	8.0	4.9	12.9
150	4.6	12.0	7.3	19.3
200	6.2	16.1	9.8	25.8
250	7.8	20.1	12.2	32.2
300	9.3	24.1	14.7	38.7
350	10.9	28.2	17.1	45.1
400	12.4	32.2	19.6	51.6
450	14.0	36.2	22.0	58.0
500	15.6	40.3	24.5	64.5
550	17.1	44.3	26.9	70.9
600	18.7	48.3	29.4	77.4
650	20.2	52.3	31.8	83.8
700	21.8	56.4	34.3	90.3
750	23.4	60.4	36.7	96.7
800	24.9	64.4	39.2	103.2
850	26.5	68.5	41.6	109.6
900	28.0	72.5	44.1	116.1
950	29.6	76.5	46.5	122.5
1000	31.2	80.6	49.0	129.0
1050	32.7	84.6	51.4	135.4
1100	34.3	88.6	53.9	141.9
1150	35.8	92.6	56.3	148.3
1200	37.4	96.7	58.8	154.8
1250	39.0	100.7	61.2	161.2

SCALE #2

TIP SIZE	1 1/8			1 1/4			1 3/8			1 1/2			1 3/4		
N.P.	40	55	70	40	55	70	40	55	70	70	85	100	70	85	100
100'	57	79	100	64	88	112	71	98	125	148	179	211	204	248	291
200'	71	97	124	84	115	146	99	137	172	218	265	312	331		
300'	84	116	147	104	142	181	126	173	220	289	351				
400'	97	134	171	123	170	216	153	211	268						
500'	111	152	194	143	197	251	180	248	316						
600'	124	171	217	163	224	285	208	286							
700'	138	189	241	183	251	320	235	322							
800'	151	207	264	203	279		262								
900'	164	226	287	223	307		290	(** Denotes Add per 50 feet.)							
1000'	178	244	311	242	333		317								
1100'	191	263		262											
1200'	204	281		282											
**	7	9	12	10	13	18	14	18	24	35	43	50	64	77	90

SCALE #4

TIP SIZE	1 1/2			1 3/4			2		
N.P.	70	85	100	70	85	100	70	85	100
5'	81	98	115	83	101	119	88	107	125
10'	84	102	120	90	109	128	99	120	141
15'	88	106	125	96	117	137	110	133	156
20'	91	110	130	102	124	146	120	146	172
25'	95	115	135	109	132	155	131	159	187
30'	98	119	140	115	140	164	142	172	203
35'	102	123	145	121	147	173	153	186	218
40'	105	128	150	128	155	182	164	199	234
45'	109	132	155	134	163	192	175	212	249
50'	112	136	160	140	171	201	186	225	265
55'	116	141	165	147	178	210	196	238	280
60'	119	144	170	153	186	219	207	252	296
65'	123	148	175	160	194	228	218	265	311
70'	126	152	180	166	202	237	229	278	
75'	130	157	185	172	210	246	240	291	
80'	133	162	190	178	218	255	251	304	
85'	137	166	195	185	226	264	262	317	
90'	140	171	200	191	234	273	273	330	
95'	144	175	205	197	242	282	284		
*	4	4	5	6	8	9	11	13	16

(* Denotes Add per 5 feet.)

1 3/8" Tip
55 P.S.I.
N.P.- 415
G.P.M.

80 P.S.I.
N.P. - 502
G.P.M.

1½" Tip
80 P.S.I.
N.P.- 597
G.P.M.

100 P.S.I.
N.P. - 667
G.P.M.

1 3/4" Tip
80 P.S.I.
N.P. - 813
G.P.M.

100 P.S.I.
N.P. - 909
G.P.M.

2" Tip
80 P.S.I.
N.P. - 1062
G.P.M.

Sprinkler System
Maintain 125 P.S.I. into System

Standpipe System
Nozzle Pressure plus 5 P.S.I. per floor plus 25 P.S.I. for the system plus friction loss for the hose.

Designed by Howard M. Hessel
Fire Engineer, C.F.D. © 1960

BOOKLET RECEIPT FORM

EXAMINATION TITLE: _____ DATE: _____

ROOM NUMBER: _____ EXAMINATION SITE: _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

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I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

I hereby acknowledge receipt of Booklet # _____ Initial * _____

*DO NOT INITIAL THIS FORM UNTIL BOOKLET HAS BEEN RETURNED BY CANDIDATE

I, the undersigned, was present at High School on January 19, 1985 to take the examination for Fire Engineer.

_____

Signature

THIS FORM IS TO BE RETURNED TO YOUR COMPANY COMMANDER UPON YOUR RETURN TO WORK.

40001

DEPARTMENT OF PERSONNEL

announces an examination for:

FIRE ENGINEER
Grade F03 - Promotional

1984 SALARY RANGE: $1,903.50 - $2,885.50 per month

CLOSING DATE FOR APPLICATIONS: Friday, September 28, 1984

DATE OF EXAMINATION: TO BE ANNOUNCED

SCOPE OF EXAMINATION:

Written test	Pass/Fail
Performance Test	90%
Seniority	10%

NOTE: The written examination will be scored on a pass/fail basis. Those candidates who pass the written test will be invited to appear for the performance test. Seniority points will be added to the score on the performance test to produce a final score. Seniority points will not be added to a failing written score to raise it to a passing score.

CLASS C LICENSE: Each candidate must possess a valid Class C Driver's License at the time of application.

SENIORITY: From a base score of 70 points, a candidate shall receive one additional point for each month of continuous service as a uniformed member of the Fire Department to a maximum of 100 points.

ELIGIBLE FOR PROMOTION: Any person employed as a Career Service Firefighter who is actually so employed, or is on leave of absence, or is eligible for reinstatement, and who has served the prescribed probationary period on or before the date of application.

84/8733/0/40001--8/15/84

AN EQUAL OPPORTUNITY--AFFIRMATIVE ACTION EMPLOYER

CITY OF — DEPARTMENT OF PERSONNEL
, MAYOR

Dear Fire Engineer candidate:

Your score on the written examination for Fire Engineer was . This is a passing score. The passing point was 60.

In approximately two months you will receive a notice to report for the next portion of this examination.

Please fill out the attached information sheet and return it by the date indicated.

Sincerely,

Commissioner of Personnel

CITY OF — DEPARTMENT OF PERSONNEL
, MAYOR

Dear Fire Engineer candidate:

We are sorry to inform you that your score on the written examination for Fire Engineer was . This is not a passing score. You will no longer be considered eligible for this position.

We will keep your name on file and notify you the next time this exam is given.

Thank you for your time and interest.

Sincerely,

Commissioner of Personnel

FIRE ENGINEER SCORE NOTICE

NAME:
ADDRESS:
CITY, STATE, ZIP:

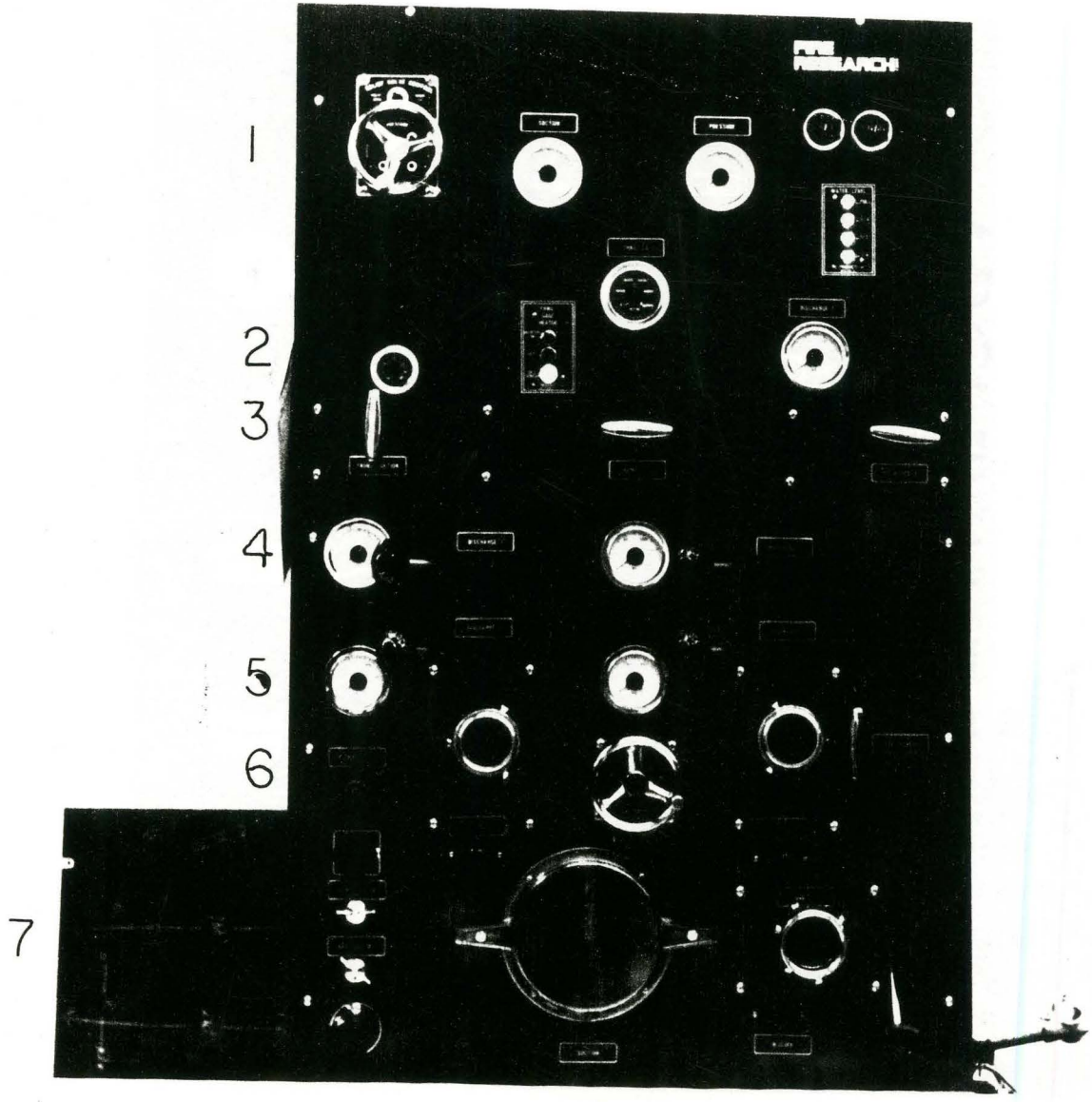
This is to notify you that we have revised our passing criteria for the Fire Engineer written examination. A raw score of 60 is now a passing score. You received a raw score of . This is a passing score. You are eligible to take the next part of the test, which is the practical test.

To schedule your appointment for the practical test, you must call at . This is not an offer of employment, merely a statement of eligibility.

Commissioner of Personnel

APPENDIX B

PILOT TEST MATERIALS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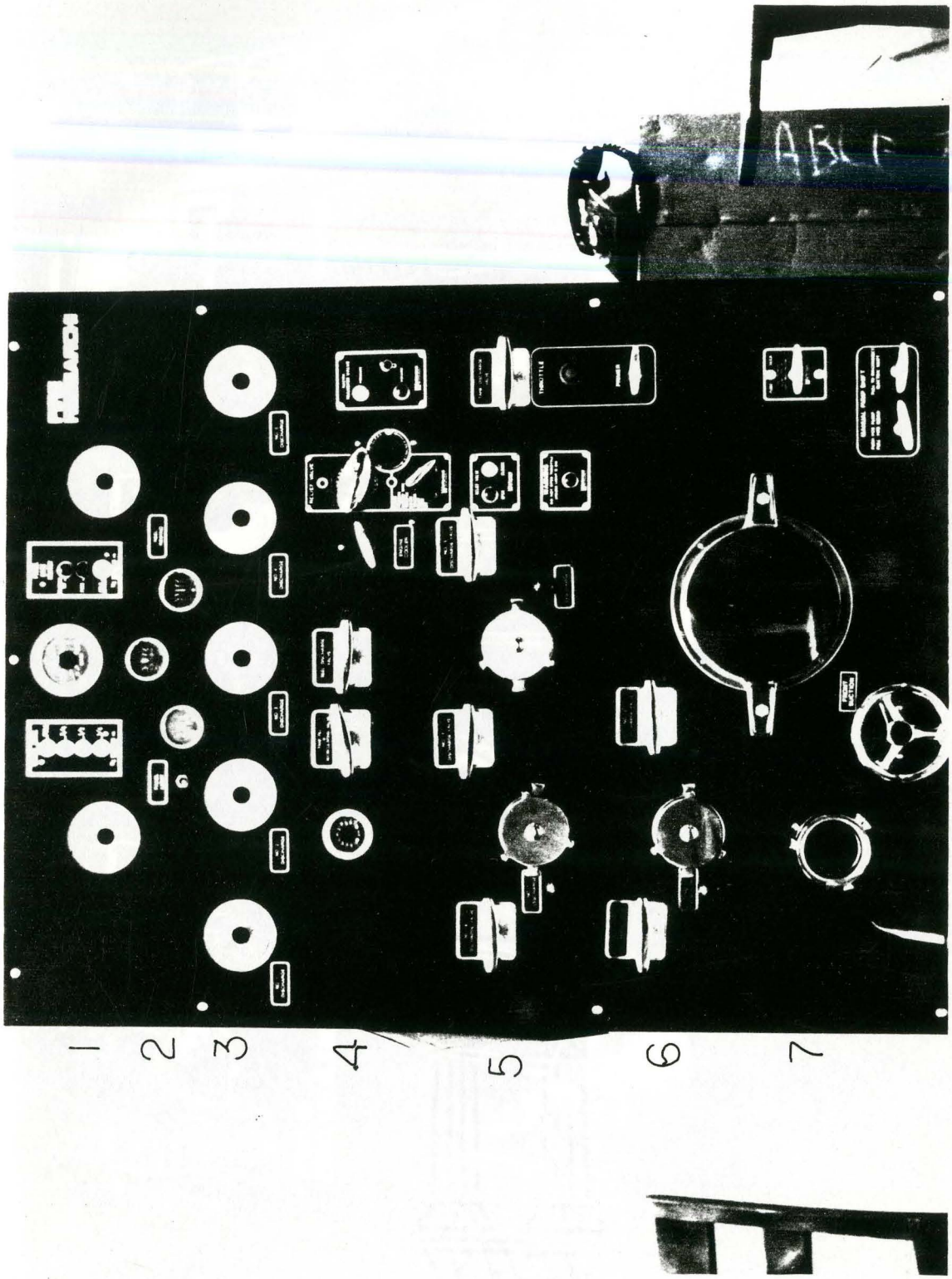
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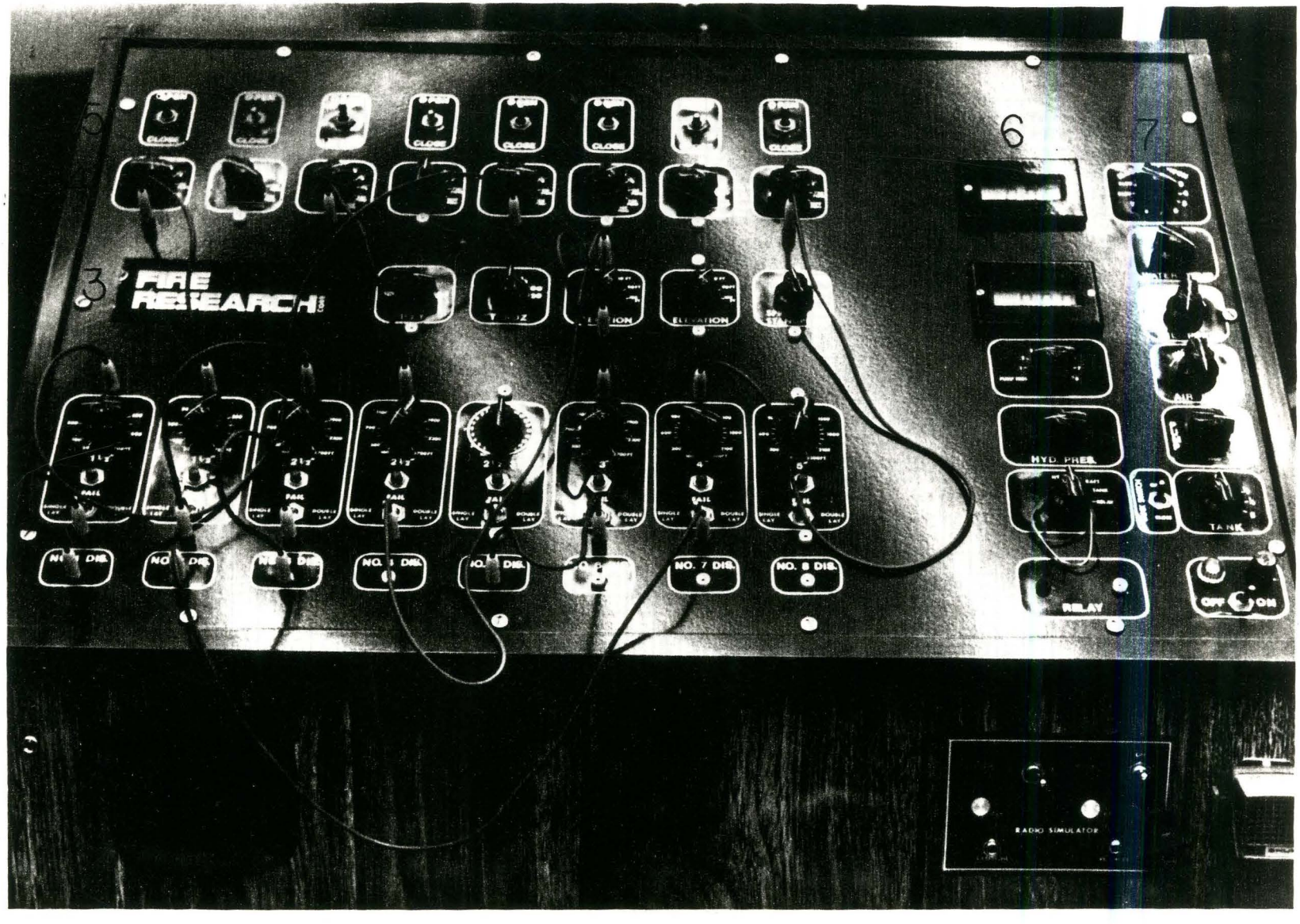
FIRE RESEARCH
ELEVATION
HYD. PRES.
AIR
TANK
RELAY
OFF
ON
NO. 7 DIS.
NO. 8 DIS.
RADIO SIMULATOR

TABLE SHOWING GALLONS OF WATER FLOWING PER MINUTE AT VARIOUS NOZZLE PRESSURES AND SIZES

NOZZLE PRESSURE	NOZZLE SIZES												
	¾"	⅞"	1"	1⅛"	1¼"	1⅜"	1½"	1⅝"	1¾"	1⅞"	2"	2¼"	2½"	3"
40	105	143	187	237	292	354	422	496	575	661	752	960	1185	1700
42	108	147	192	243	299	363	432	508	589	678	770	982	1213	1745
44	110	150	196	248	306	372	442	520	603	694	788	1004	1241	1783
46	113	154	200	254	313	380	452	531	617	710	808	1026	1269	1819
48	115	157	205	259	320	388	462	543	630	725	824	1048	1297	1856
50	118	160	209	265	326	396	472	554	643	740	840	1070	1325	1892
52	120	164	213	270	333	404	481	565	656	754	857	1091	1349	1925
54	122	167	217	275	339	412	490	576	668	769	873	1112	1373	1955
56	124	170	221	280	345	419	499	586	680	782	889	1133	1397	1980
58	127	173	225	285	351	426	508	596	692	796	905	1154	1321	
60	129	176	229	290	357	434	517	607	704	810	920	1175	1445	
62	131	179	233	295	363	441	525	617	716	823	936	1194	1467	
64	133	181	237	299	369	448	533	627	727	836	951	1213	1489	
66	135	184	240	304	375	455	542	636	738	850	965	1232	1511	
68	137	187	244	308	381	462	550	646	750	862	980	1251	1533	
70	139	190	249	313	386	469	558	655	761	875	994	1270	1555	
72	141	192	251	318	391	475	566	665	771	887	1008	1287	1577	
74	143	195	254	322	397	482	574	674	782	900	1023	1304	1599	
76	145	198	258	326	402	488	582	683	792	911	1036	1322	1621	
78	147	200	261	330	407	494	589	692	803	924	1050	1339	1643	
80	149	203	264	335	413	500	596	700	813	935	1063	1356	1665	
82	151	205	268	339	418	507	604	709	823	946	1076	1373	1686	
84	152	208	271	343	423	513	611	718	833	959	1089	1384	1705	
86	154	210	274	347	428	519	618	726	843	970	1102	1400	1725	
88	156	213	277	351	433	525	625	735	853	991	1115	1415	1745	
90	158	215	280	355	438	531	633	743	862	992	1128	1430	1765	
92	160	218	283	350	443	537	640	751	872	1003	1140	1445	1785	
94	161	220	286	363	447	543	647	759	881	1012	1152	1460	1805	
96	163	222	289	367	452	549	654	767	890	1022	1164	1475	1825	
98	165	225	292	370	456	554	660	775	900	1033	1176	1490	1845	
100	168	227	295	374	461	560	667	783	909	1043	1189	1505	1865	

Name:_____ Date:_____/_____/__

Social Security Number:_____ Simulator H W

Rater:_____

	Exercise #1		Exercise #2		Exercise #3		Exercise #4	
Problem Number								
Engine Pressure Desired								
Engine Pressure Calculated/Time								
Candidate got water to pump before using throttle or discharge	YES	NO	YES	NO	YES	NO	YES	NO
Candidate charged lines using low pressure	YES	NO	YES	NO	YES	NO	YES	NO
Candidate opened the proper discharge gate	YES	NO	YES	NO	YES	NO	YES	NO
Engine Pressure Set/Time								
Nozzle Pressure Desired								
Nozzle Pressure Set								
Candidate verbally stated use of safety hitch	YES	NO	YES	NO	YES	NO	YES	NO
Candidate set relief valve	YES	NO	YES	NO	YES	NO	YES	NO
Cand. set relief valve properly	YES	NO	YES	NO	YES	NO	YES	NO
Tachometer Reading								
Candidate has pump in which mode	P	V	P	V	P	V	P	V
Pump mode desired					P	V	P	V
Candidate slammed discharge gate	YES	NO	YES	NO	YES	NO	YES	NO
Candidate has one discharge gate fully open	YES	NO	YES	NO	YES	NO	YES	NO
Candidate lowered RPM's by throttle before closing gate	YES	NO	YES	NO			YES	NO
Candidate closed all gates	YES	NO	YES	NO			YES	NO
Candidate closed front suction	YES	NO	YES	NO			YES	NO
Candidate allowed a 20 PSI (or more) drop or increase on a flowing line when charging additional lines							YES	NO
Changed from P to V correctly							YES	NO

City of
Department of Personnel

FIRE ENGINEER - SIMULATOR EXAMINATION
PROCTOR GUIDE

Fill in all information at the top of the rating form i.e., name, date, social security number, simulator choice and initials of rater.

YOU WILL BE GIVEN A TOTAL OF FOUR (4) HYDRAULICS PROBLEMS TODAY. YOU WILL FIRST COMPUTE A PROBLEM AND GIVE ME YOUR ANSWER. THEN I WILL TELL YOU WHICH PORT TO PUT IT ON.

NOW TAKE A FEW MOMENTS TO FAMILIARIZE YOURSELF WITH THE PUMP PANEL AND THEN SET IT UP AS YOU NORMALLY WOULD FIRST THING IN THE MORNING, USING WARM WEATHER OPERATIONS.

Give the candidate no more than three minutes to set up and look over the simulator. Then begin with Exercise #1.

Record: Problem Number

Problem #1 & Problem #2

I WILL READ YOU A HYDRAULIC PROBLEM. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY".

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

YOU ARE OPERATING AT A HYDRANT, YOU HAVE A 1250 G.P.M. PUMPER WITH A SOFT SUCTION ON THE FRONT INTAKE. OPEN YOUR FRONT INTAKE NOW, BUT DO NOT DO ANYTHING ELSE UNTIL I TELL YOU TO DO SO.

Record: Pump mode at start
Opened proper intake

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO."

Start timing immediately and stop timing when the candidate says "Ready" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Allowed 30 PSI or more overpressure
Maximum pressure (Pump or Discharge)
Exceeded 200 PSI
Engine pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used refief valve to control discharge
Changed pump mode/correctly

NOW SHUT THAT LINE DOWN COMPLETELY. YOU ARE GOING BACK TO QUARTERS.

Record: Discharge gates slammed open or closed
Candidate lowered RPM's slowly before closing gate
Gates are closed slowly
Front suction is closed slowly

Record: Problem Number

Problem #3

I WILL READ YOU YOUR THIRD HYDRAULICS PROBLEM. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY."

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the Problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

YOU ARE OPERATING AT A HYDRANT, YOU HAVE A 1250 G.P.M. PUMPER WITH A SOFT SUCTION ON THE FRONT INTAKE. OPEN YOUR FRONT INTAKE NOW, BUT DO NOT DO ANYTHING ELSE UNTIL I TELL YOU TO DO SO.

Record: Pump mode at start
Opened proper intake

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO."

Start timing immediately and stop timing when the candidate says "ready" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Allowed 30 PSI or more overpressure
Overpressure amount
Exceeded 200 PSI
Discharge pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used relief valve to control discharge
Changed pump mode/correctly
Discharge gates slammed open or closed

Record: Problem Number

Problem #4

NOW I WILL GIVE YOU ANOTHER LEAD OUT TO BE PUT ON AN ADDITIONAL PORT. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVAED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY."

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the Problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO".

Record: PSI Range (High-Low) in line pressure on the other line (from Problem #3) while this line is being charged.

Start timing immediately and stop timing when the candidate says "READY" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Exceeded 200 PSI
Discharge pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used relief valve to control discharge
Changed pump mode/correctly

NOW SHUT THOSE LINES DOWN COMPLETELY. YOU ARE GOING BACK TO QUARTERS.

Record: Discharge gates slammed open or closed
Candidate lowered RPM's slowly before closing gate
Gates are closed slowly
Front suction is closed slowly

APPENDIX C

PRACTICAL TEST MATERIALS

FIRE ENGINEER

Name: _____ Date: ____/____/____

Social Security Number: ___/___/____ Simulator H W 583

Rater ____/____

	Exercise #1		Exercise #2		Exercise #3		Exercise #4	
Problem Number								
Engine Pressure Calculated								
Problem Solving Time	: .		: .		: .		: .	
Pump Mode at Start	P	V	P	V	P	V	P	V
Candidate Opened Proper Intake	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Charged Lines Using Low Pressure	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Opened the Proper Discharge Gate	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Allowed a 30 PSI (or more) Overpressure While Charging a Line	Yes	No	Yes	No	Yes	No		
Maximum Pressure (Pump or Discharge)								
Candidate Exceeded 200 lbs. Pressure (Pump or Discharge)	Yes	No	Yes	No	Yes	No	Yes	No
Discharge Pressure Set								
Discharge Pressure Set Time	: .		: .		: .		: .	
Nozzle Pressure Set								
Tachometer Reading								
Candidate Has One Discharge Gate Fully Open	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Verbally Stated Use of the Safety Hitch	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Set Relief Valve	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Set Relief Valve Properly	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Used Relief Valve to Control Discharge Pressures	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Changed Pump Mode	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Changed Pump Mode Correctly	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Slammed Any Discharge Gate Open or Closed	Yes	No	Yes	No	Yes	No	Yes	No
Candidate Lowered RMP's Slowly by Throttle Before Closing Gate	Yes	No	Yes	No			Yes	No
Candidate Closed All Gates	Yes	No	Yes	No			Yes	No
Candidate Closed Front Suction	Yes	No	Yes	No			Yes	No
Candidate Allowed a 20 PSI (or more) Drop or Increase on a Flowing Line When Charging Additional Lines							Yes	No
PSI Range (High-Low)							High - Low	

City of
Department of Personnel

FIRE ENGINEER - SIMULATOR EXAMINATION
PROCTOR GUIDE

Fill in all information at the top of the rating form i.e., name, date, social security number, simulator choice and initials of rater.

YOU WILL BE GIVEN A TOTAL OF FOUR (4) HYDRAULICS PROBLEMS TODAY. YOU WILL FIRST COMPUTE A PROBLEM AND GIVE ME YOUR ANSWER. THEN I WILL TELL YOU WHICH PORT TO PUT IT ON.

SCRATCH PAPER AND A CALCULATOR ARE PROVIDED FOR YOUR USE.

REMEMBER, THIS MACHINE IS A PIECE OF ELECTRONIC EQUIPMENT. EVERYTHING WORKS EASILY. DO NOT FORCE ANY OF THE HANDLES.

HALE ONLY

THE "TANK TO PUMP" VALVE IS A "PUSH OR PULL" HANDLE ONLY. DO NOT TWIST IT.

THE DISCHARGE GATES ON THE HALE PUMP ARE CLOSED WHEN THE HANDLES ARE TO THE LEFT.

WATEROUS ONLY

THE "TANK DISCHARGE VALVE" IS A "PUSH OR PULL" HANDLE ONLY. DO NOT TWIST IT.

THE "RELIEF VALVE" SHOULD ONLY BE TWISTED. DO NOT PULL ON THIS HANDLE. ALSO, REMEMBER TO LISTEN FOR THE CLICK ON THE FOUR-WAY VALVE TO BE SURE THAT IT IS ACTIVATED.

NOW TAKE A FEW MINUTES TO FAMILIARIZE YOURSELF WITH THE PUMP PANEL AND THEN SET IT UP AS YOU NORMALLY WOULD FIRST THING IN THE MORNING, USING WARM WEATHER OPERATIONS.

THIS MACHINE IS ALREADY SET UP IN PUMP FOR YOU.

Give the candidate no more than three minutes to set up and look over the simulator. Then begin with Exercise #1.

Record: Problem Number

Problem #1 & Problem #2

I WILL READ YOU A HYDRAULICS PROBLEM. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY".

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

YOU ARE OPERATING AT A HYDRANT, YOU HAVE A 1250 G.P.M. PUMPER WITH A SOFT SUCTION ON THE FRONT INTAKE. OPEN YOUR FRONT INTAKE NOW, BUT DO NOT DO ANYTHING ELSE UNTIL I TELL YOU TO DO SO.

Record: Pump mode at start
Opened proper intake

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO."

Start timing immediately and stop timing when the candidate says "Ready" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Allowed 30 PSI or more overpressure
Maximum pressure (Pump or Discharge)
Exceeded 200 PSI
Discharge pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used refief valve to control discharge
Changed pump mode/correctly

NOW SHUT THAT LINE DOWN COMPLETELY. YOU ARE GOING BACK TO QUARTERS.

Record: Discharge gates slammed open or closed
Candidate lowered RPM's slowly before closing gate
Gates are closed slowly
Front suction is closed

Record: Problem Number

Problem #3

I WILL READ YOU YOUR THIRD HYDRAULICS PROBLEM. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY."

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the Problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

YOU ARE OPERATING AT A HYDRANT, YOU HAVE A 1250 G.P.M. PUMPER WITH A SOFT SUCTION ON THE FRONT INTAKE. OPEN YOUR FRONT INTAKE NOW, BUT DO NOT DO ANYTHING ELSE UNTIL I TELL YOU TO DO SO.

Record: Pump mode at start
Opened proper intake

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO."

Start timing immediately and stop timing when the candidate says "ready" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Allowed 30 PSI or more overpressure
Maximum pressure (pump or discharge)
Exceeded 200 PSI
Discharge pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used relief valve to control discharge
Changed pump mode/correctly
Discharge gates slammed open or closed

Record: Problem Number

Problem #4

NOW I WILL GIVE YOU ANOTHER LEAD OUT TO BE PUT ON AN ADDITIONAL PORT. YOU ARE TO COMPUTE THE ENGINE PRESSURE NEEDED AND SAY "READY" WHEN YOU HAVE ARRIVAED AT AN ANSWER. YOU WILL BE SCORED ON HOW ACCURATE YOUR ANSWER IS AND HOW LONG IT TOOK YOU TO COMPUTE IT.

AFTER I READ THE PROBLEM, I WILL SAY "READY, GO", AND THEN START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY."

ONCE YOU SAY "READY" YOU WILL NOT BE GIVEN ADDITIONAL TIME TO COMPUTE OR BE GIVEN AN OPPORTUNITY TO CHANGE YOUR ANSWER.

Read the Problem and say "READY, GO." Stop the timing when the candidate says "READY."

Record: Engine pressure calculated
Problem solving time

NEXT, YOU WILL BE SCORED ON HOW LONG IT TAKES YOU TO SET THE PUMP AT YOUR COMPUTED PRESSURE AS WELL AS HOW ACCURATELY YOU SET IT.

(Pressure set by candidate must be the pressure he computed).

I WILL SAY "READY, GO" AND START TIMING. I WILL STOP TIMING WHEN YOU SAY "READY." THIS WILL INDICATE TO ME THAT YOU HAVE ARRIVED AT THE PRESSURE YOU DESIRE TO SET.

WHEN I SAY "READY, GO", I WANT YOU TO PUT THE ENGINE PRESSURE YOU JUST CALCULATED ON DISCHARGE #_____.

ARE THERE ANY QUESTIONS? "READY, GO".

Record: PSI Range (High-Low) in line pressure on the other line (from Problem #3) while this line is being charged.

Start timing immediately and stop timing when the candidate says "READY" (Do not allow relief valve to be set at this point).

NOW STEP BACK FROM THE PUMP AND DO NOT TOUCH ANY OF THE CONTROLS UNTIL I TELL YOU TO DO SO.

Record: Charged lines using low pressure
Opened proper discharge gate
Exceeded 200 PSI
Discharge pressure set/time
Nozzle pressure set
Tach reading

IS THERE ANYTHING ELSE YOU WOULD DO AT THIS POINT?

Record: One discharge fully open
Safety hitch used
Relief valve set/properly
Used relief valve to control discharge
Changed pump mode/correctly

NOW SHUT THOSE LINES DOWN COMPLETELY. YOU ARE GOING BACK TO QUARTERS.

Record: Discharge gates slammed open or closed
Candidate lowered RPM's slowly before closing gate
Gates are closed slowly
Front suction is closed

Before the candidate leaves make sure of the following:

The calculator is returned
The scrap paper, if used, is collected
Both raters must sign the rating form on the back

Dismiss the candidate

Set up for next candidate:

Clean off any grease pencil marks
Relief valve on the high side
Gates closed etc.

Anything that you have to do to a pumper out on the street you have to do to these simulators in order to make them work.

On the Hale type pump simulator, this will be your compound gauge and it registers your hydrant pressure. Out on the street, if you didn't open your front suction to get water into your pump, you couldn't pump any water. It's the same way here. This is your front suction and you open it like this. Now hydrant pressure is being registered on the compound gauge.

This is your main pump pressure gauge. If you close your front suction you'll lose your pressure.

This gauge shows the coolant temperature in your radiator. It can change. Your engine can overheat. A diesel normally runs at about 195 degrees Farenheit. If you see the coolant temperature going above 210 degrees, tell me about it. It's very important that you tell me everything you're going to do, especially because we're not going to attach hose here today. If you should start to overheat, tell me that you're overheating and that you're going to use your auxiliary cooler. It's right down here. You open it up, and given time, your temperature will come back down into normal operating range. When you're comfortable with that range, turn off the auxiliary cooler.

This is your oil pressure gauge and it can also change.

These are your tank level indicators. If you are given a problem in which you use your tank water, the water level will drop all by itself, depending on your pipe size and your nozzle pressure. If you see that your water level is running low, and you decide that you want to get a line from your hydrant, or from another engine, into your auxiliary intake, tell me. Putting a line into your auxiliary intake and opening it up will enable you to be supplied by hydrant pressure.

The large black faced dial is your tachometer. Right now it's idling at about 550 RPM. The small black faced dial is your air pressure gauge and it tells you how much air pressure you have for blowing out your hard line. It will not change.

There are three push-pull handles here. The first one is the front suction. The second one activates your hard line. The third is discharge gate #5, which is a rear discharge port.

On the side of the apparatus is discharge gate #1 & #2. The gate, handle and the gauge for #1 and the gate, handle and the gauge for #2.

Discharge gates three and four will be on the opposite side of the apparatus. Here is the control handle for #3 and the control handle for #4.

Hale pumps use a manual transfer valve so we have one here. Right now it is set in the pressure mode. However you would run your pumper out on the street, do it here. If you normally run in pressure, leave it in pressure. If you normally run in volume, change it to volume.

To change from pressure to volume is simple. Crank the handle until you hear a click. The click comes from an electrical switch which we need on this machine. To change back to pressure, crank the handle until you hear the click again and you'll be back in pressure.

If you decide that you want to change modes while pumping, you must throttle down to an idle, switch it over and then bring the pressure back up to where you want it.

The small black knobs are bleeders for discharge gates #1 & #2. That means that you won't have bleeders for gates #3, #4, and #5.

This is your throttle. It operates the same as a throttle on a pumper. As you turn the throttle out, the tachometer will increase, when there is water in your pump your pressures will go up. To reduce your tach and your pressure, turn the throttle in. Do not use the Quick Release.

This is your priming pump. In order to draft water with this machine, you have to go into volume, bring your RPM's up to between 1200 and 1500 and then engage your priming pump. You can tell that you're getting water by watching your pump pressure gauge.

This switch controls your pump cooler. When you're using your tank water you have to dump your water into the pump and you're probably using your hard line. In this situation it's a good idea to use your pump cooler because it will help to recirculate your water back to the tank in order to keep the pump cool, since a hard line uses only about 28 G.P.M.

Your auxiliary cooler is here and it's used to keep your radiator cool.

This is the main draft. When it's open on the street you'll get wet feet and the pump would not draft. Here you won't get wet feet, but the pumper will not draft.

Here is the auxiliary intake. In the down position it will be shut off.

This is the relief valve. It operates the same way as the Hale relief valve on the trucks. As you are setting your pumper up in the morning you would normally turn this valve until it would bind up. This machine is different in that the valve will not bind up. If you give it about seven or eight revolutions to the right, you've set it on the high side. To put it into operation, if you would normally use it, and it's up to you, you would first set your discharge pressures using your gates and your throttle. Get your pressures exactly the way you want them, take a mental note of your pump pressure and then decrease the pilot gauge. As you bring this

down you will notice a decrease in your pump pressure and the red light will go on. Bring it right back to where you want it and leave it alone. The red light should be out. The way that we will test to see if the relief valve is set correctly is that we will shut off a pipe from the control panel. When we close a pipe, the red light should come on immediately. When we open the pipe, the water begins to flow again and the light will go out - if the relief valve is set properly.

We're going to be looking for a couple of things. On all of our straight bore hand pipes like our one and one-half inch, we want 50 pounds nozzle pressure and multiversals with a straight tip 80 lbs. HP. All fog pipes 100 lbs. NP. with the exception of our Bell Fog pipe - but we won't be using a Bell Fog here today.

The second thing that we have to watch for is if you have one line already charged and flowing and you're asked to charge a second line at the same time. The minute you start to open that second line your pressure will drop. If possible, don't let it drop or increase by more than 20 lbs.

That means that you're going to have to watch and work between your discharge gates and your throttle. You have to maintain the pressure on your first line while you're charging the second one.

If you would like, on top of each machine there is a yellow grease pencil. It's there for your use because we're not going to attach hose and if it would help you to remember that on this part you

have 3" hose and it is 400' long and you need 72 lbs. engine pressure. You can write it right on the glass. Write only on the glass. Then when you're through you can take the log and wipe it off.

On the side of each machine is a Hensels Chart if that's what you use and we have a Flow Chart on the other side that tells you how many gallons per minute are flowing at a given nozzle size and pressure. That will determine which mode you run your pumper in. If you know that new flow system, it works very well on these machines.

FOR OFFICE USE ONLY

NAME: _____

SOCIAL SECURITY NUMBER: _____

PLATOON (Circle one)

1.
2.
3.
40 Hour Employee

OFF DAY (Circle One)

A.
B.
C.
D.
E.
F.

FURLOUGH PERIOD (Circle One)

8	12	OTHER (SPECIFY)
9	13	
10	14	
11	15	

I wish to take the Performance (Simulator) Test on a (Circle One)

Hale Pump Panel

Waterous Pump Panel

_____ DATE: _____
Signature

Return by May 15, 1985 to:

DEPARTMENT OF PERSONNEL
EXAMINATION DIVISION - FIRE ENGINEER EXAM
CITY HALL

NOTICE
CITY OF
DEPARTMENT OF PERSONNEL

FIRE ENGINEER #40001
SIMULATOR TEST

DATE:_____

PLACE: Fire Academy

TIME:_____ _____PUMP

Any necessary scratch paper will be furnished by the Department of Personnel. A calculator will also be furnished. No books, notes or papers are permitted.

Bring this notice, several sharpened #2 pencils and a record of your Social Security number with you to the examination site.

If you must reschedule your appointment you must do so through the Department of Personnel at .

NOTE: You will not be allowed to park on or in the Drill Yard.

Commissioner of Personnel

FIRE ENGINEER EXAMINATION SCORE NOTICE
#40001

Dear Candidate:

This is to notify you that you received a final score of
on the Fire Engineer examination. This is a passing
score. Your name, therefore, has been placed on the
Eligible List for this examination with a rank of .

Commissioner of Personnel

KEEP THIS NOTICE FOR YOUR RECORDS

4/86

FIRE ENGINEER EXAMINATION SCORE NOTICE
#40001

Dear candidate:

We are sorry to inform you that your final score on the Fire Engineer examination is . The minimum passing score is 70. Your score, therefore, is not a passing score. We can no longer consider you for this position.

Thank you for your time and interest in applying for promotion. We will keep your name on file and notify you of the next examination for Fire Engineer.

Commissioner of Personnel

KEEP THIS NOTICE FOR YOUR RECORDS

4/86

APPROVAL SHEET

The thesis submitted by Joseph W. Giganti
has been read and approved by the following committee:

Dr. Scott Tindale, Director
Associate Professor, Psychology, Loyola

Dr. Fred Bryant
Associate Professor, Psychology, Loyola

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of
Master of Arts.

4/14/87
Date

R. Scott Tindale
Director's Signature