UNIVERSITY OF JORDAN
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A QUALITY CONTROL EXPERT SYSTEM FOR INSPECTION BY ATTRIBUTES ISO 2859

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FOR INSPECTION BY ATTRIBUTES

ISO 2859

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Dedication

To my beloved father Basim, mother Khawla,

husband Saleh, my brothers Bassam & Ghassan,

my sister Mona and my niece Sarah.

ACKNOWLEDGMENT

I would like to express my gratitude and sincere regards to Prof.Arun Walvekar, my thesis advisor, for his unlimited support and guidance during the course of this research and in preparing this document. I would also like to extend my deepest appreciation to the members of my committee, Dr.Bassam Talhouni for providing me with useful references and Dr.Abed AL Rahim Jalad for his support.

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ABSTRACT

Recently there has been an increasing demand for expert systems. Expert Systems exist in a wide spectrum of problem areas including monitoring and control of real-time systems, medical diagnosis, on line scheduling, banking, analytical chemistry and many other applications.

Expert systems have many benefits such as captured scarce expertise, cost reduction, increased output, improved quality, improved system performance and reliability, increased ability to solve complex problems and many other benefits.

This research focuses on the Quality Control problem. An expert system in the domain of Quality Control for inspection by attributes using the International Standard ISO 2859 was developed. The system employs the sampling plans' tables and the switching procedures included in the standard. The system is responsible for selecting an attribute sampling plan given specific sampling plan criteria. It is used as a tool to assist quality inspectors that use ISO 2859 to evaluate the performance or products of their organization.

The final output of this research is an efficient working expert system software ready to be implemented in the real world.

ملخـــــص

لقد شهد الطلب على الانظمة الخبيرة مؤخرا زيادة مستمرة. وتتوفر الانظمة الخبيرة في مجالات واسعة لتقدم حلولا لمسائل متعددة منها الرقابة والسيطرة على انظمة الوقت الحقيقي، والتشخيصي الطبي، والجدولة الانتاجية، والعلوم المصرفية، والكيمياء التحليلية وتطبيقات اخرى.

وللنظم الخبيرة فوائد كثيرة منها امكانية تمثيل الخبرات النادرة، وتخفيض الكلفة، وزيادة الانتاج وتحسين الجودة ورفع مستوى الاداء والموثوقية للانظمة، وزيادة امكانية تقديم الحلول للمسائل المعقدة اضافة الى فوائد كثيرة اخرى.

يركز هذا البحث على مسالة ضبط الجودة، حيث تم تطوير نظام خبير في مجال ضبط الجودة لفحص الخصائص المميزة باستخدام المواصفات الدولية (ISO 2859) . ويستخدم النظام المقترح جداول اختيار العينات واساليب الانتقال من مستوى شدة الى اخر في خطط اختيار العينات، الواردة في المواصفات المشار اليها. ويقوم النظام بانتقاء الخطة الملائمة لاختيار العينات ذات الخصائص المميزة استنادا الى معايير محددة ومعطاة لتلك الخطة. وعليه يمكن استخدام النظام المقترح كاداة مساعدة لمراقبي الجودة الذين يستخدمون المواصفات الدولية (ISO 2859) في تقييم مستوى الاداء او المنتجات في مؤسساتهم.

اما الناتج النهائي لهذا البحث فهو نظام خبير ذو كفاءة وجاهزية للاستخدام العملي.

CHAPTER ONE

INTRODUCTION

1.1 GENERAL

Computers date back to the Second World War, when the programmable computers were devised to aid in cryptography. Since then, computers have focused on numerical calculations and have become very powerful tools for solving complex and time-consuming arithmetics. Recently a new generation of computing technology and capability,referred to as Artificial Intelligence (AI) is taking place. It's characterized by its ability to emulate human intelligence functions. According to Webster's dictionary, the human intelligence is defined as *"the ability to learn or understand from experience; ability to acquire and retain knowledge; mental ability; the ability to respond quickly and successfully to a new situation; use of faulty reason in solving problems; directing conduct, etc..effectively.* " Thus one of the chief objectives of AI is to program computers to exhibit behavior that we call intelligent behavior as defined above, when we observe it in human beings.

1.2 WHAT IS ARTIFICIAL INTELLIGENCE ?

Artificial Intelligence or AI is an all embracing term used to label any system that behaves as though it has intelligence.(1) AI also means the part of computer science concerned with the development of intelligent computer systems which involve human-like senses and reasoning. AI is also the study of how to make computers do things, at the moment, people do, better.

Artificial Intelligence is an ancient myth that became true in the twentieth century. As a science, AI has matured over the past 50 years in North America, Japan and Europe.Most AI research had been theoretical until 1955 when the first AI chess program came into existence. One of the earliest AI languages, which is no longer in use, is the IPL (Information Processing Language) invented by Newell. This language was like machine language rather than a high level language. LISP (LISt Processing) was introduced by John McCarthy, a leading AI researcher, in the same period of time. At the present time, there are other languages in use such as InterLisp, SWL, Planner, KRL and PROLOG (PROgramming in LOGic). However, the two higher-level languages most commonly used for AI programming are Lisp and PROLOG.

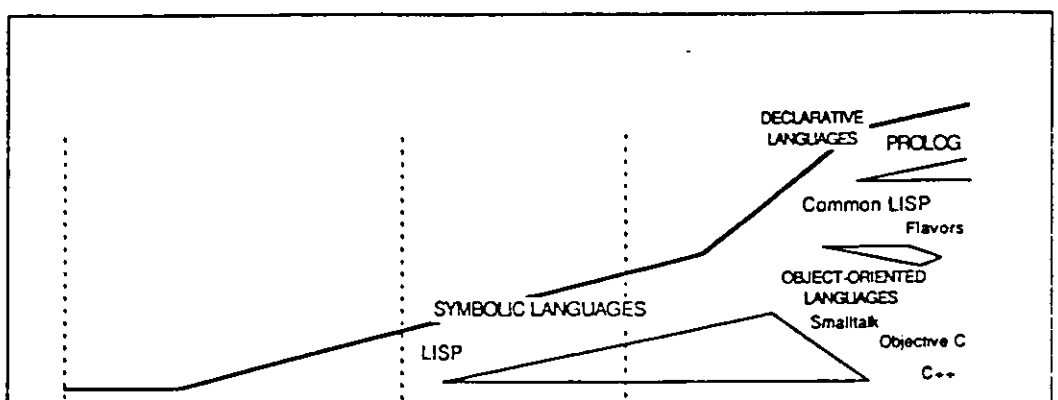


Fig.[1.1]: The evolution of computer languages (2)

1.3 APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Applied AI research concentrates on several different areas,most notably natural language processing, expert systems, artificial senses, robotics, learning systems and game-playing. The following diagram illustrates more task domains of AI.

Mundane Tasks

- Perception
  - Vision
  - Speech
- Normal language
  - Understanding
  - Generation
  - Translation
- Commonsense reasoning
- Robot control

Formal Tasks

- Games
  - Chess
  - Backgammon
  - Checkers
  - Go
- Mathematics
  - Geometry
  - Logic
  - Integral calculus
  - Proving properties of programs

Expert Tasks

- Engineering
  - Design
  - Fault finding
  - Manufacturing planning
- Scientific analysis
- Medical diagnosis
- Financial analysis

Fig.[1.2] : Some of the Task Domains of Artificial Intelligence (3)

A - Natural Language Processing NLP

The most common way that people communicate is by speaking or writing in one of the natural languages like Arabic, English, French, etc.. NLP is the research which is concerned with dealing with the full range of meaning in languages. It's chief objective is to develop computer hardware and software that will allow computers to interact with people in a natural language, in other words,the computer will be able to comprehend instructions given in natural language and will be able to generate ordinary natural language which can be understood by people easily.

B - Expert System ES

They are often referred to as knowledge-based systems. These are intelligent computer programs which have the ability of a human expert in some narrow field of knowledge to reason about and solve difficult problems, which are based on conclusions drawn from stored knowledge about a certain domain. Expert systems will be discussed later.

C - Artificial Senses

These are specialized computer programs which simulate human senses such as vision, speech and smell. These systems serve diverse industries such as automotive assembly, food processing, medical components, electronics, etc.. They are incorporated in assembly lines, Quality control and many other applications.

D - Robotics

It's a general research program whose objective is the construction of a complete artificial simulation of a human being, presumably including both mental and physical attributes.

E - Learning Systems

These are systems whose ultimate objective is to make programs that learn from their experience as effectively as humans do. They deduce new facts from their knowledge base. Learning systems can be considered part of expert systems.

F - Game - Playing

One of the earliest AI game-playing programs is the Alex Bernstein's chess program, which used 6x6 board and barely made legal moves. Later, very sophisticated chess programs were developed. Other targets for game-playing research include Othello, checkers and Go. Most game-playing programs use heuristic search methods, which carts problem-solving in terms of an abstract space of all possible solutions, together with operations that transform one state in that space into another, using heuristic "rule of thumb" to guide and constrain the process.

1.4 EXPERT SYSTEMS (ES)

What is an expert system ?

There are a lot of definitions of expert systems. The following definition will suffice for the purpose of this thesis.

" Expert System is a computer system containing specialized knowledge about some specific area of human activity. This knowledge is organized in such a way as to enable the system to enter an interactive dialogue with a user concerning matters in that field, in the course of which it can offer intelligent advice or propose sensible decisions and also explain the line of reasoning underlying its advice and proposals." (4)

The activity of designing and implementing expert systems involves the transfer of knowledge from experts (human experts, manuals or standards) to computer programs. This transfer process is referred to as knowledge engineering, therefore, expert systems are also called knowledge based systems.

1.5 STRUCTURE OF EXPERT SYSTEMS

An expert system generally consists of three main components: a Knowledge Base, an Inference Engine and a User Interface. Other ES components may include Working Memories, Database(s), Knowledge Acquisition Subsystem and an Explanation Subsystem.

The following diagram illustrates the Architecture of a typical expert system.

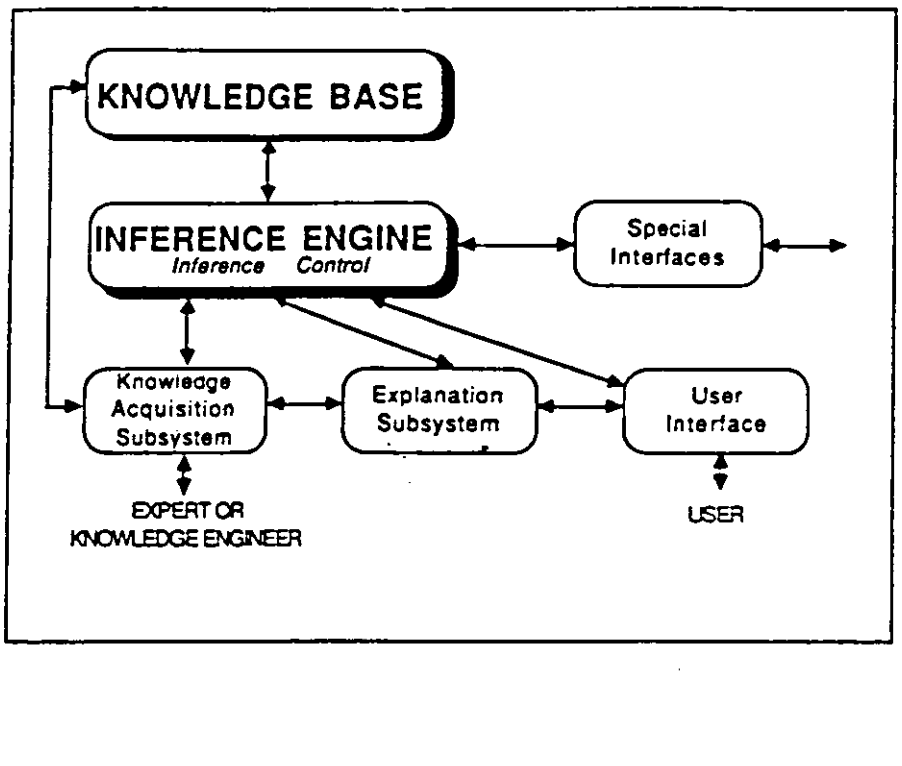


Fig.[1.3] : Architecture of a typical expert system (2)

The knowledge base : it contains rules, data, facts and problem solving know-how representing the knowledge of an expert(s) in a particular domain.

The inference engine : it is the heart of the expert system. It contains mechanisms, strategies and controls used to manipulate and apply knowledge to the problem. Inferences and new facts are derived from the knowledge base.

The user interface : it controls interaction with the user. It contains screen displays, menus and a questioning strategy.

The knowledge acquisition subsystem : it provides means of creating and amending the knowledge base.

The explanation subsystem : it provides means of displaying the content of the knowledge base.

The working memory : it serves as a temporary cache for information specific to the problem currently being solved.

1.6 FEATURES OF EXPERT SYSTEMS

Expert systems differ in their nature, objectives and applications. Despite these differences, Expert system share some common features which are the following :

1. The expert system must be useful. The program should be developed to meet certain need, one for which it is recognized that assistance is needed.

2. The expert system should be usable. The program must be built in order to help the novice computer user to use the computer easily.

3. The expert system must respond to simple questions. Due to the fact that people with different levels of knowledge may use the system, the expert system should be able to answer questions about anything that might not be clear to the user.

4. The expert system knowledge base can be easily modified. It is important that one is able to revise the data base, correct any existing errors or add new information.

5. The expert system must provide the reasoning behind the advice or recommendations it makes in order to allow the user to decide whether to accept those recommendations and conclusions or not. (5)

1.7 APPLICATIONS OF EXPERT SYSTEMS

Expert systems exist in a wide spectrum of problem areas including monitoring and control of real-time systems, medical diagnosis, on-line scheduling, computer network diagnosis etc.. Table [1.1] shows ten different system applications categorized according to function.

In this research, an expert system in the field of Quality Control will be developed.

TABLE [1.1] : EXPERT SYSTEM CATEGORIES (6)

CATEGORY	PROBLEM ADDRESSED
Interpretation	inferring situation description from sensor data.
Prediction	inferring likely consequences of given situation.
Diagnosis	inferring system malfunctions from observation.
Design	configuring objects under constraints.
Planning	designing actions.
Monitoring	comparing observations to plan vulnerabilities.
Debugging	prescribing remedies for malfunctions.
Repair	executing plans to administer a prescribed remedy.
Instruction	diagnosing, debugging, and repairing student behavior.
Control	interpreting, predicting, repairing, and monitoring system behavior.

1.8 BENEFITS OF EXPERT SYSTEMS

Benefits of ES include the following :

- cost reduction,
- increased output,
- improved quality,
- reduced downtime,
- captured scarce expertise,
- consistency of employee output,
- flexibility in providing services,
- easier operation of equipment,
- increased system reliability,
- faster system response,
- ability to work with incomplete and uncertain information,
- improved employee training,
- increased ability to solve complex problems.

1.9 WHAT IS QUALITY CONTROL ?

All human societies make use of natural and artificial materials and forces to provide products. Most enterprises (industries, schools,companies, etc..)strive for high standard of performance for their products, systems and services. They work in such a way, to assure that their goods, systems and services meet the specifications and expectations of customers and others in their business environment.In practice, however, there are always some tangible extent of nonconformance to specifications . The concept of Quality Control has evolved to help all concerned vendors, processors, consumers, etc.. to secure improved quality performance. Quality control is defined as " the regulatory process through which we measure actual quality performance, compare it with standards, and act on the difference." (7) This involves product inspection and testing by a specialized quality control department which utilizes the different tools, skills and techniques which are developed by scientists in the field of Quality Control.

1.10 INSPECTION AND TEST : PRODUCT ACCEPTANCE

All inspection (and test) involves some form of evaluation of product, comparing this evaluation with some standard, and judging whether there is conformance and thereby accept or reject the product.

A product can be a discrete unit, a collection of units - a lot- or can also exist in a bulk, e.g. coils of wire. The standards for quality are usually in the inspection plans and sampling criteria which are published by the quality control department. The amount of inspection

needed to decide the acceptability of a lot can vary from no inspection to 100 percent inspection. The actual amount of inspection needed is governed mainly by the amount of prior knowledge available on the quality and the homogeneity of the lot.

No inspection is appropriate in cases where prior inspections on the same lot have already been made by qualified laboratories. While, small samples can be adequate in cases where the process is inherently uniform and the order of production can be preserved. Large samples are taken in the absence of prior information on the lot quality. The need for 100 percent inspection is in the cases when the results of sampling show that the level of defects present is too high to go on to the user. Usually 100 percent inspection is done automatically to reduce inspection costs, reduce error rates, alleviate personal shortages, shorten time of inspection, avoid inspector monotony and many other advantages.

1.11 ACCEPTANCE SAMPLING

Acceptance sampling is " the process of evaluating a portion of the product in a lot for the purpose of accepting or rejecting the entire lot as either conforming or not conforming to a quality specification."(8) Acceptance sampling is used when 1) inspection is destructive, 2) cost of inspection is high, 3) when 100 percent is monotonous, causing inspection errors.

The main advantage of sampling is economy. The disadvantages are sampling risks, administrative costs, and less information about the product than is provided by 100 percent inspection.

1.12 TYPES OF SAMPLING PLAN

A sampling plan indicates the number of units of product from each lot or batch to be tested (sample size) and the criteria for determining the acceptability of the lot.

Sampling plans are two types :

1. *Attributes plans* : a random sample is taken from the lot and each unit is classified as acceptable or defective. The number defective is then compared with the allowable number stated in the plan, and a decision is made to accept or reject the lot.(8) Some standard sampling plans are the International Standard ISO 2859 (Military Standard 105D), the Dodge-Romig Sampling Tables and others.

2. *Variables plans* : a sample is taken and a measurement of a specified quality characteristic is made on each unit. These measurements are then summarized into a simple statistic (e.g. sample average) and the observed value compared with an allowable value defined in the plan. A decision is made to accept or reject the lot. (8)

1.13 THESIS OBJECTIVE

The primary objective of this research is to develop an expert system in the field of Quality Control, specifically for inspection by attributes using the International Standard ISO 2859 / Military Standard MIL-STD-105D. The expert system will be capable of selecting the appropriate sampling plan, and to be able to switch between the three levels of severities of inspection (normal, reduced or tightened inspection) according to the rules that are set by the above mentioned standard (for more details see chapter three) in an interactive user friendly manner. Help menu and screens will be embedded in the system to introduce the user to the concepts and terminology used by ISO 2859.

The expert system to be implemented is not meant to be a complete system that solves all problems in the quality domain. Instead, it is a pilot system that demonstrates the implementation of the basic concepts underlying expert systems.

CHAPTER TWO

LITERATURE REVIEW

2.1 THE HISTORY OF ARTIFICIAL INTELLIGENCE

The concrete intellectual groundwork for later Artificial Intelligence research was laid in the 1940's and early 1950's by thinkers like Alan Turing. In the 1950's and 1960's, AI research achieved publicity with attempts at playing chess and translating among languages. However, only a few agencies were willing to invest in AI during the 1970's. But, over the last decade, a great deal of academic research has been carried out in this area, and the pace is being stepped up worldwide. This is often referred to as the fifth computer revolution. Table [2.1] summarizes the most important events in the history of AI.

TABLE [2.1] : IMPORTANT EVENTS IN THE MODERN HISTORY OF AI (9)

1936	Turing formalizes the notion of a general purpose computer.
1945	Von Neumann conceives "stored program" design for serial digital computers.
1946	ENIAC, the first implemented general-purpose digital computer, dedicated.
1950	Turing describes his test for machine intelligence. Shannon speculates on the prospects for computer chess.
1955	Bernstein develops first working chess program.
1956	McCarthy organizes the Dartmouth Conference and coins the term **artificial intelligence.**
	Newell, Shaw, and Simon develops the **Logic Theorist**, the first successful AI program.
1957	McCarthy invents Lisp (LISt Processor),the first popular AI programming language.
	Newell, Shaw, and Simon begin the ambitious **General Problem Solver.**
	Chomsky introduces transformational grammar to model the syntax of natural languages.

1965	Feigenbaum develops **Dendral**, the first expert system. Dreyfus publishes "Alchemy and Artificial Intelligence" paper.
1966	Quillian invents the semantic network.
1967	Greenblatt develops **MacHack** , the first competent chess program.
1970	Winston's " learning Structural Descriptions from Examples" pioneers machine learning.
	Colmerauer invents Prolog AI programming language.
1972	**MYCIN**, first practical expert system to use production rules, developed.
	Winograd completes **SHRDLU** natural language processing program.
1974	Minsky publishes " A Framework Representing Knowledge" paper.
1975	The Lisp Machine, the first specialized AI computer, invented at MIT.
	First personal computers are sold.
1982	Marr's revolutionary, comprehensive theory of vision published.
	Japanese "Fifth Generation" AI research effort begins.
1986	Thinking Machines Corporation introduces the Connection Machine.
	Berliner's HiTech is first chess computer to receive Senior Master title.
	First 32-bit microcomputers become widely available.
1988	The introduction of the 486 high speed processors.
1989	Start of using software engineering tools in expert systems. Linking AI programs with conventional database applications.(3)
	Widespread of expert shells,such as Xi-plus.
1990	New patents & Semantic network machine for AI computers Japan system and method for parallel processing with mostly functional languages. U.S.A. (14)
1991	World congress on Expert Systems, Dec.16-19,1991, U.S.A.

The rest of this chapter will introduce some of the commonly available expert systems.

2.2 DENDRAL

This is the first expert system developed in Stanford University's Heuristic Programming project starting in 1965. The team included Bruce Buchanan, Edward Feingenbaum, and Joshua Lederberg. The system predicts the molecular structure of chemical compounds based on the interpretation of the data obtained from mass spectrometer and nuclear resonance (NMR) spectrometer. Dendral, however, lacks the reasoning from basic principles of chemistry, therefore its domain is very narrow, and its explanation is minimal.

Since its completion Dendral has been in daily international use by chemists. Subsequent chemical applications include Meta Dendral (also for structure elucidation); CRYSALIS (x-ray crystallography); and CHASA, SECS, and SYNCHEM (all in synthetic chemistry)

2.3 MYCIN

MYCIN was the first medical application system for blood disease diagnosis, developed in the early 1970's by Buchanan and Shortlife at Stanford University. MYCIN's expertise lies in the domain of bacterial infections. It helps the physician to prescribe disease-specific drugs. MYCIN informs itself about a particular case by requesting information from the physician about a patients symptoms, general condition, history and laboratory-test-results. At each point,the question MYCIN asks is determined by MYCIN's current hypothesis and the answers to all previous questions.

MYCIN's pool of knowledge consists of approximately 500 rules, which give MYCIN the ability to recognize about 100 causes of bacterial infections.

2.4 DART

DART is a recent Stanford program for automated diagnosis of physical systems. It is able to diagnose failures in digital electronic circuits. While its main application thus far has been electronic circuits, it has been used in connection with nuclear reactors.

2.5 PROSPECTOR

It was created at Stanford Research Institute (SIR) in the late 1970's. It is designed to assist geologists with mineral exploration problems. It has Knowledge of a dozen models of ore deposit patterns and characteristics.

2.6 XCON / XCEL

XCON was developed by John McDermott and his associates beginning in 1980. It configures Digital Equipment Corporation Vax minicomputer systems for customer orders. It checks an order for omissions and errors, lay out the various components in the required cabinetry, and creates floor and cable layouts for the equipment. XCON and its family such as XCEL, is written in OPS5, an expert system programming language. It has nearly 10,000 rules and knows the properties of several hundred component types for VAX computers, made by Digital Equipment Corporate. XCON routinely handles orders involving 100 to 200 components. XCON is now used to configure all Vax mainframes.

2.7 MACSYMA

MACSYMA is a gigantic and comprehensive symbolic mathematics system. It is an expert system in integration, differentiation, vector analysis, linear algebra, and more. Currently MACSYMA is extensively used by mathematician and scientists.

2.8 ISIS

Developed in the early 1980's by the Intelligent Systems Laboratory with cooperation of Mark Fox and Stephen Smith for the Robotics Institute at Carnegie-Mellon University. ISIS is factory automation system designed to produce job-schedules. ISIS considers variables such as productivity goals, resource requirements, and machine preferences to construct schedules, monitor performance and avoid production bottlenecks.(1)

2.9 THE MUD SYSTEM

MUD is a drilling fluid diagnostic and treatment consultant recently developed at Carnegie-Mellon University in cooperation with ND Baroid. MUD, now containing about 1600 rules, was developed by Cary Kahn and John McDermott in 1985.

MUD is an expert system that provides diagnostic and treatment recommendations to engineers responsible for maintaining desired properties of oil well drilling fluids. The system, implemented in OPS5 production system, is based on forward-chaining matching strategies. MUD does not take into account uncertainty factors, assuming that all data entered as well as the recognition of diagnostically significant observations is certain .

2.10 GENESIS (GENETIC Engineering Scientific Systems)

GENISIS analyzes data regarding composition of DNA and reports finding to research geneticists.

2.11 LENDING ADVISOR

Development of Lending Advisor began in 1984. The first prototype was created on Xerox D series machine using Syntelligence's own LISP based tool called Syntel. Lending Advisor is a large, multi-user, generic expert system that evaluates commercial loan applications, defines the level of potential risk associated with loans and helps structure loans accordingly. In addition, the system reviews existing loans by evaluating the borrowers current financial condition to red flag potential problems and suggests remedial action.

2.12 SEATS

Airline Seat Advisor was developed by programmers at IntelliCorp in a joint effort with Sperry and NorthWest Orient Airline. NorthWest Orient worked with the programmers as domain experts. The purpose of this system is to assist pricing analysts in adjusting the number of discount seats available on airline routes.

2.13 UNIK-FCST

This system was developed at the Korea Advanced Institute of Science and Technology, in 1990. Unified Knowledge-Forecast (UNIK-FCST) is a statistical expert system that solves the problem of accounting future events and other qualitative factors in the time series models. This system learns from historical judgmental adjustments through generalization and analogy. This means that this system uses monotonic reasoning. The system uses predicate calculus for knowledge representation, and uses PROLOG as an implementation language. This system

takes into account certainty factor during the reasoning process. (2)

Since the key issue of our research is to develop an expert system to substitute a major section of the International Standard ISO 2859, the next chapter will be devoted to the introduction of the above mentioned standard.

CHAPTER THREE

THE INTERNATIONAL STANDARD ISO 2859

(MILITARY STANDARD MIL-STD-105D)

3.1 INTRODUCTION

The International Standard *ISO 2859* - Sampling Procedures and Tables for inspection by attributes - was originally prepared for making lot decisions on military products, but is now in general use for both military and civilian products. It comes in the form of a handout of the collection of sampling procedures and tables. It is used for receiving inspection, within-house inspection between departments and final inspection. It is used in attribute inspection, on either defectives or defects.

The basic objective of ISO 2859 is the maintenance of the outgoing quality level at a given "acceptable quality level" (AQL) or better. There are two criteria of quality level, either of which may be specified, namely, percent defective, that is defectives per hundred units, or secondly defects per hundred units. Defects are classified as critical, major or minor according to their seriousness.

The standard is designed so that the producer runs consistently at precisely the AQL, then the great majority of his lots/batches can be expected to pass. But, if his process is at even a little worse than the AQL, he can expect to have trouble and must face "tightened inspection". The producer is, therefore, advised to run at or better than AQL.

AQL values range from 0.010 to 1000.0 . The values of AQLs given in ISO 2859 are known as preferred AQLs. If, for any product, an AQL be designated other than preferred AQLs, the tables in the specified standard are not applicable.

ISO 2859 provides seven "inspection levels", which give different sample sizes to give relatively lower or higher discriminating power.The inspection level determines the relationship between the lot/batch size and sample size. Three inspection levels; I,II & III are given for general use where inspection level GII is regarded as normal and is usually used unless otherwise specified. Level GI may be specified when less discrimination is needed or level GIII may be used for greater discrimination. The other levels are special levels - S-1,S-2,S-3 & S-4 - and may be specified where relatively small sample sizes are necessary and large sampling risks can or must be tolerated.

There are three types of sampling plans in ISO 2859 : single, double and multiple. A decision as to the type of plan to be used is usually based upon the comparison between the administrative difficulty and the average sample sizes of the available plans. The average sample size of multiple plans is less than double (except in the case corresponding to single acceptance number) and both of these are always less than a single sampling size. Usually the administrative difficulty for single sampling and the cost per unit of the samplware less than for double or multiple.

ISO 2859 includes provision for tightened inspection if quality deteriorates and reduced inspection if the inspection records have been good. All changes between severities levels of inspection are governed by rules associated with the sampling scheme. Normal inspection is

generally adopted at the beginning of a sampling procedure and continued until evidence of either lower or higher quality than that specified exists. Schematically, the rules of switching between the different severities which are specified in ISO 2859 are given in figure [3.1].

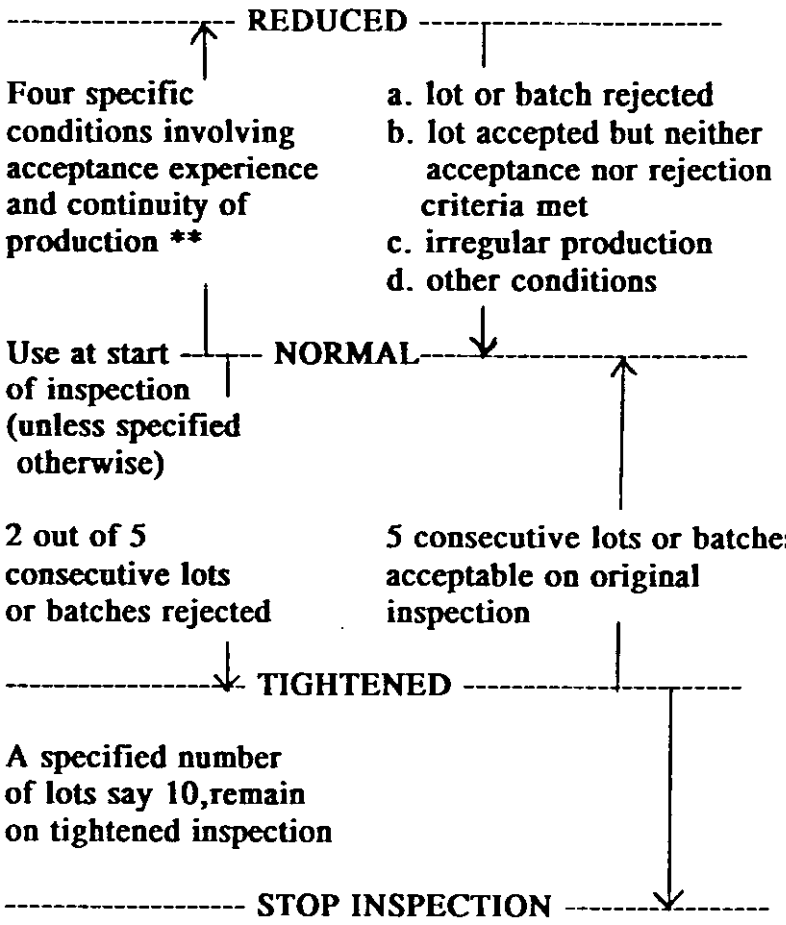


Fig. [3.1] : Rules for switching inspection severity (7)

a. The preceding 10 lots or batches have been on normal inspection and none has been rejected on originalwnspection; and

b. The total number of defectives (or defects) in the samples from the preceding 10 lots or batches is equal to or less than the acceptable number given in table VIII (MIL-STD-105D). If double or multiple sampling is in use, all samples inspected should be included, not "first" samples only; and

c. Production is at steady state; and

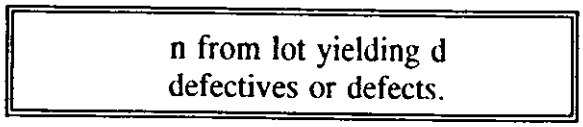
d. Reduced inspection is considered desirable by the responsible authority.

The military standard also provides operating characteristics curve for most of the plans. The OC curve is a graph of the percent defective in a lot versus the probability that the sampling plan will accept a lot. From the OC curve, one can determine producer and consumer risks. It also provides a table of Average Outgoing Quality Limit (AOQL) values for each of the single sampling plans for Normal and Tightened inspection. AOQL is the maximum of Average Outgoing Quality (AOQ) for all possible incoming qualities for a given acceptance sampling plan. The AOQ is the average quality of outgoing product including all accepted lots, plus all rejected lots after the rejected lots have been effectively 100 percent inspected and all defectives replaced by nondefectives.

To determine a specific sampling plan, one must decide on the following :

1. lot size. This need not a production lot size.
2. Inspection level (usually GII).
3. Type of sampling plan (single, double or multiple).
4. Whether to start with normal (almost always), tightened or reduced sampling.
5. Desired AQL: for percent defectives (10.0 or less) or defects per hundred units.

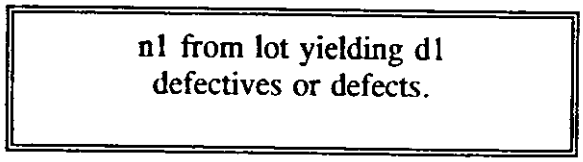
The acceptance of a lot/batch depends on the type of the sampling plan. In single sampling, just one sample of n pieces is drawn at random and inspected, from which a decision is always made. In double sampling, after the first sample is inspected we may accept, reject or reqwre a second sample. After the later is inspected then a decision is always rendered. Multiple sampling is similar to double sampling except that one might have to inspect up to seven samples to reach a decision. This is best illustrated in the following flowcharts.



Accept lot ----- d = < Ac

d = > Re ----- Reject lot

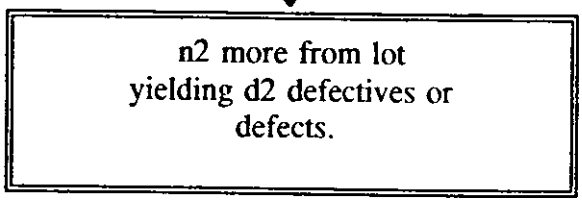
Fig.[3.2] : Single Sampling Flowchart



Accept lot ----- d1 = < Ac1

d1 = > Re1 ----- Reject lot

Ac1 < d1 < Re1



Accept lot ----- d1+d2 = Ac1 d1+d2 = > Re1 ----- Reject lot

Fig.[3.3] : Double Sampling Flowchart

CHAPTER FOUR

SYSTEM DEVELOPMENT

4.1 INTRODUCTION

The development of an expert system consists of many activities. Figure [4.1] illustrates a broad overview of the entire expert system's development and implementation process.

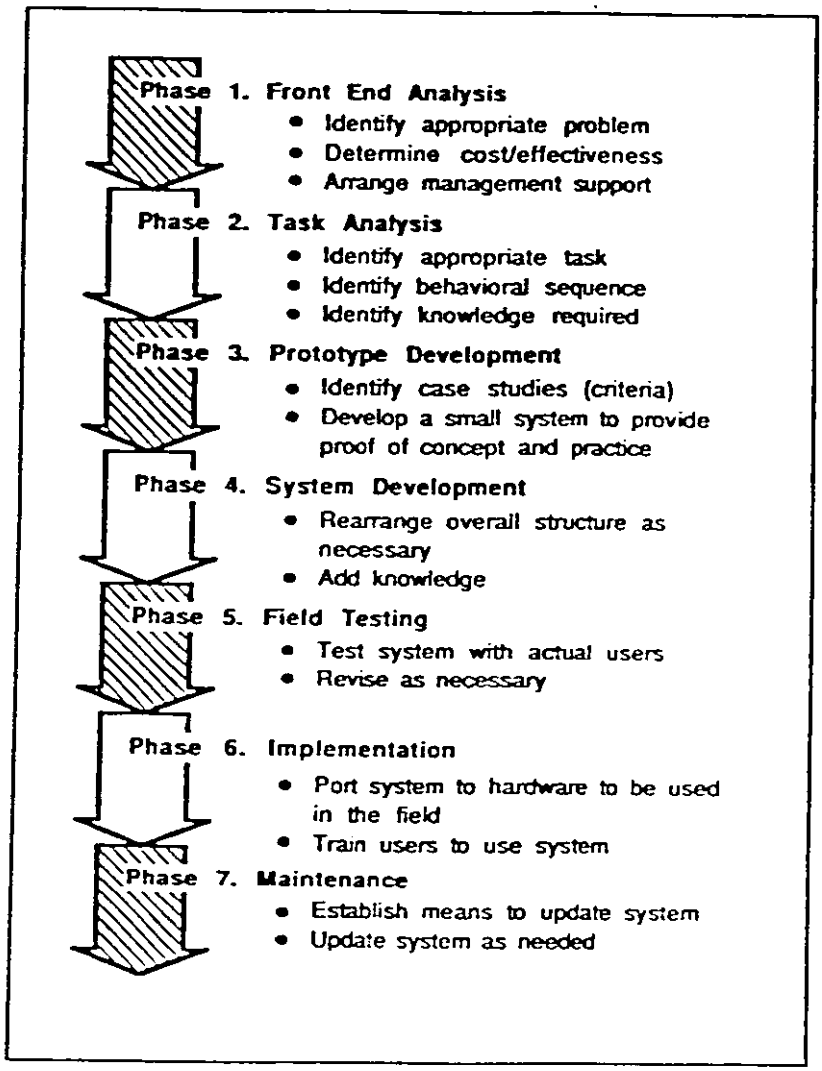


Fig.[4.1] :Seven steps in expert system development. (2)

The seven phases described in figure [4.1] constitute a systematic way to approach developing an expert system. In reality, phases tend to get mixed together. All phases are iterative in nature, and dependant on each other; the output from a certain phase may suggest modifications in other phases. The seven phases are discussed in the following sections.

4.2 PHASE 1 FRONT END ANALYSIS

In the initial phase, one selects the appropriate problem or problems the system will work on. Front end analysis involves all the questions one should ask before beginning an expert system. At this stage it is imperative to identify clearly the goals and criteria of the system. In other words, one needs a clear statement of what the expert system is supposed to do. This will provide the information to use as a benchmark of comparison for the eventual development of the prototype system.

As far as this research is concerned, the general problem definition and objectives were clearly stated in chapter one section 1.13. The system is developed to assist quality inspectors in determining sampling plans for inspection by attributes using the International Standard ISO 2859 (MIL-STD-105D).

4.3 PHASE 2 TASK ANALYSIS *(Knowledge Acquisition)*

The second phase includes all the activities involved in obtaining information from experts. In this phase one studies how the target task is currently performed, meets with the human experts and develops criteria to determine if the resulting system is successful. One also

studies how the new system would best fit into the environment and the exact nature and knowledge one hopes to capture in the expert system.

In this research, the domain experts are the International Standard ISO 2859 (MIL-STD-105D) - Sampling Procedures and Tables For Inspection by attributes - and quality inspectors. Currently quality inspectors select a sampling plan by using the tables provided by the above mentioned standard. He/She keeps historical records on the inspected items in order to be able to decide on switching between normal, reduced or tightened inspection. This involves a lot of tedious and monotonous work.

The developed expert system determines sampling plans, and creates and updates a database for each inspected item. This database will then be examined to decide on the switching between the three severity levels. The expert system was developed in such a way that any person with minimal computer know-how will be able to operate it easily.

4.4 PHASE 3 PROTOTYPE DEVELOPMENT

Having completed phases one and two, the next step is to develop a small version of the expert system to demonstrate the overall flexibility of the system. This involves establishing concepts representing knowledge by describing the key concepts of the problem domain, interrelationships in the problem domain and the flow of information needed to describe the problem-solving process (i.e.forward or backward chaining). Also the formats used for knowledge representation are selected (semantic networks, production rules or frames) .

Finally, once a prototype is running efficiently, it becomes the model of the planned complete expert system. Normally, at this stage, adjustments are made to the performance and capabilities of the proposed system.

4.4.1 KNOWLEDGE REPRESENTATION

Knowledge representation (KR) means encoding real world knowledge in a format both readable and understandable by the computer. Knowledge can take many forms : static knowledge (facts about objects), surface knowledge (superficial rules of thumb knowledge), deep knowledge (based on system design and functional requirements), procedural knowledge ("knowing how" step-by-step algorithms and declarative knowledge ("knowing what";describes the information necessary to solve the problem in a general way without a direct method for its solution.) . Most knowledge types can be considered as procedural and declarative types. Using the appropriate representation facilitate problem solving in knowledge based systems.

Categories of Knowledge Representation :

1. **Logical Representation Schemes** : it uses expressions in formal logic to represent a knowledge base. Inference rules and proof procedures apply this knowledge to problem instances.

Example : deduce that it is sunny if it is not raining.

It is raining

RAINING

It is sunny

SUNNY

If it is raining then it is not sunny.

2. Procedural Representation Schemes : it represents knowledge as a set of instructions for solving a problem.

Example : Production Systems

Production systems are based on a set of If-Then implication based representation (rules) that modify the existing database. They contain a fact database, rule base and a set of meta-rules that manipulate other rules. Each rule contains several if pattern and one or more then patterns.

```
Rn    If     if1
             if2
             ..
             ..
      then   then1
             then2
             ....
```

3. Network Representation Schemes : it captures knowledge as a graph in which nodes represent objects and the arcs represent relations or associations between them.

Example : semantic nets

Ross Quillian was the first researcher to introduce semantic networks for representing commonsense knowledge-information about objects, people, concepts and the specific relationships between them. A typical semantic network is shown in figure [4.2].

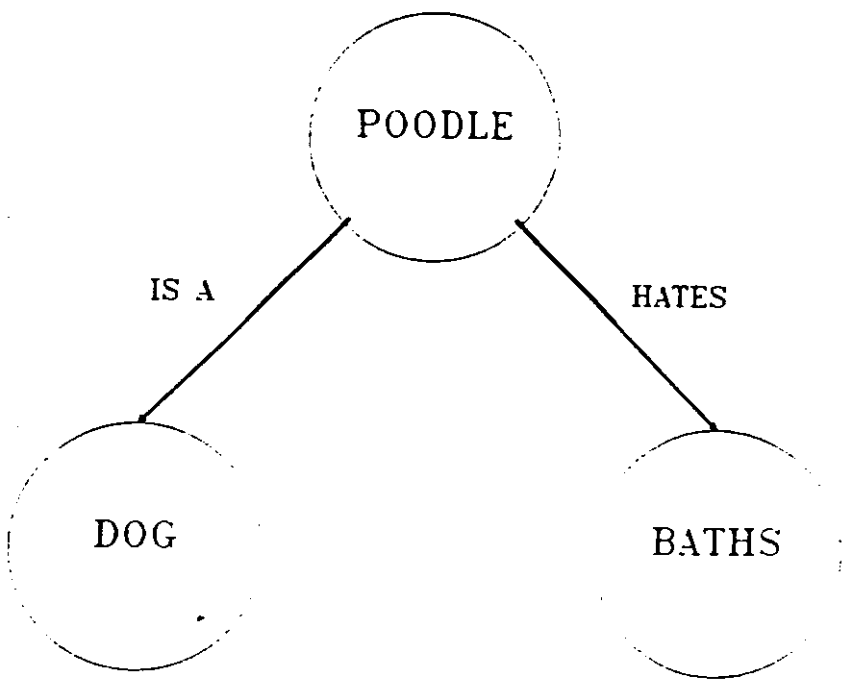


Fig.[4.2] : Semantic net

4. Frames : they were first introduced by Marvin Minsky in 1975. These structures can usually be viewed as complex semantic nets, but they typically have a great deal of internal structure designed to make them useful in specific kinds of problem-solving tasks. Figure [4.3] illustrates how a semantic net can be converted into a collection of frames.

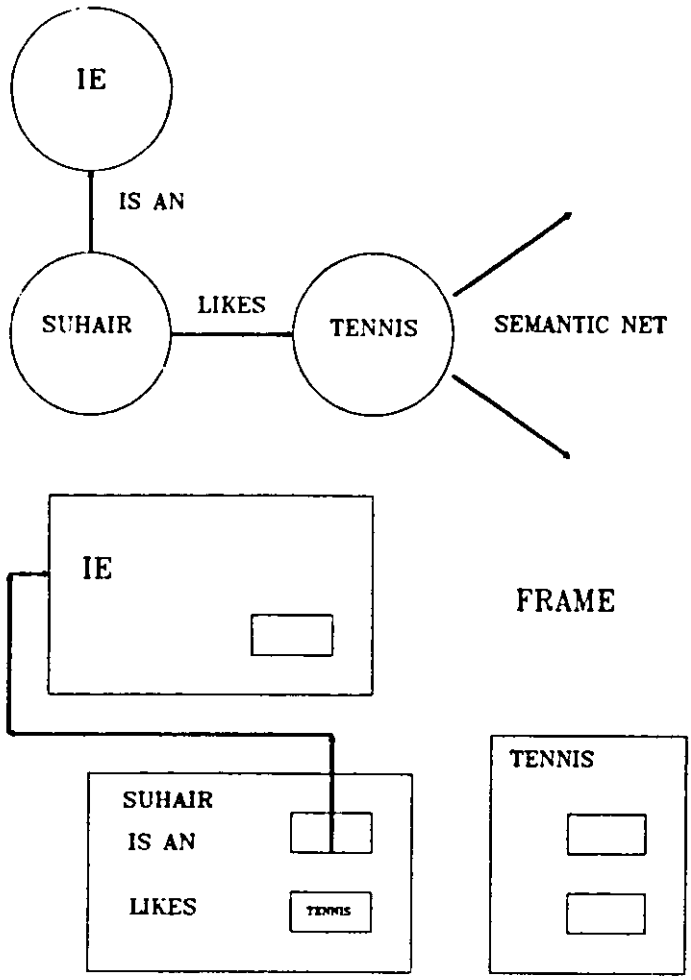


Fig.[4.3] : Each node is shown as a frame with slots or slot values. As the figure illustrates, slot values may be shown as frame names or as links connected to frames.

Each node and the links that emanate from it can be collected together and called a frame. Graphically, frames may be shown in an alternate, rectangle-and-slot notation. Each frame's name is the same as the name of the node on which frame is based. The names attached to the slots are the names of the links emanating from the frame's node.

NAME	
SLOT - 1	FILLER
SLOT - 2	FILLER
. .	. .
SLOT - N	FILLER

Fig.[4.4] : A General Structure of a Frame

Note that each frame is structured like a database record (slot & fillers, fields & values) and the whole system can be thought of as a database with inheritance properties.

Frames generally have the following properties :

1. They provide a structured representation of individual objects (instance frames or instances) or entire classes of objects (class frames or classes).

2. Value inheritance : an object can automatically take on all the properties of its superclasses without adding a single node or a link (i.e. move default slot values from classes to instances).

3. Procedures attachment (if-needed demons) . These procedures sit in the filler field until someone asks for it. When they are activated, existing slot values are replaced by new values computed by the demons. This feature gives a frame database virtually limitless flexibility.

4. Frames allow one to determine description of objects in the absence of specific knowledge; this means that in the case where recent knowledge is not readily existing about an object, the system can use already existing knowledge that is stored in that object-frame (the default features of the object).

5. They can represent rules. Rules can also be grouped into classes, and the description of a rule can include arbitrary attributes of the rule.

4.4.2 Knowledge Representation Scheme Used In This Research

Choosing the appropriate knowledge representation for a particular application can be a key issue in system development. One should be aware of the type of knowledge that is involved in the system. The knowledge involved in this research ia a combination of factual and heuristic knowledge. Factual knowledge is best represented by frames and heuristic knowledge by production rules (if..then pattern).

4.4.3 Implementation Language

Expert systems could be coded using AI languages (e.g.LISP, PROLOG) or even conventional third-generation languages. But, for rapid reproduction of expert systems, new tools called expert shells have been developed. An ES shell is a software containing a collection of capabilities that enable the users to develop ES. Shells contain knowledge representation structures necessary to capture and structure expertise; an inference engine facilitating use of that expertise; development tools which the knowledge engineer can use to capture, understand

and manipulate knowledge; an interface used by the end user to provide input and examine the system's conclusions and mechanisms interfacing the ES with other software systems.

In this research, FoxPro /Lan version 2.0 [(c) foxholdings 1989-1991, Pacific Edition] was used. FoxPro language, although highly procedural, supports a variety of desirable AI programming features such as modular programming, capability of representing symbolic data, string pattern matching, separation of knowledge from the control structure and an interactive system communication capability. It was also taken advantage of the SQL (Structure Query Language) commands; mainly the conditional select command embedded in FoxPro.

The system was developed to run on IBM PCs and compatibles, under MS-DOS operating system, in a single user mode.

4.4.4 Knowledge Structure

The knowledge base contains the actual knowledge that can be used in problem-solving. In this research, the factual knowledge has been encoded using frames. Frames can be thought of as relational database. Each frame comprises of a set of related data items that can uniquely identify a particular object through its values stored in the frame slots. In this research, the object is the sampling plan for inspection by attributes. The following diagrams show the different frames used in this research and the data slots (fields) associated with each frame.

Frame name : SSPN/SSPR/SSPT

SAMPLE SIZE CODE LETTER	DATA
SINGLE SAMPLE SIZE	....
AQL	....
SINGLE SAMPLING ACCEPTANCE NUMBER	....
SINGLE SAMPLING REJECTION NUMBER	DATA

Fig.[4.5] : Single sampling plan representation

Frame name : DSPN/DSPR/DSPT

SAMPLE SIZE CODE LETTER	DATA
SAMPLE NUMBER	....
DOUBLE SAMPLE SIZE	....
CUMULATIVE SAMPLE SIZE	....
AQL	....
DOUBLE SAMPLING ACCEPTANCE NUMBER	....
DOUBLE SAMPLING REJECTION NUMBER	....
SINGLE SAMPLE SIZE	....
SINGLE SAMPLING ACCEPTANCE NUMBER	....
SINGLE SAMPLING REJECTION NUMBER	DATA

Fig.[4.6] : Double sampling plan representation

Frame name : MSPN/MSPR/MSPT

SAMPLE SIZE CODE LETTER	DATA
SAMPLE NUMBER	....
MULTIPLE SAMPLE SIZE	....
CUMULATIVE MULTIPLE SAMPLE SIZE	....
AQL	....
MULTIPLE SAMPLING ACCEPTANCE NUMBER	....
MULTIPLE SAMPLING REJECTION NUMBER	....
SINGLE SAMPLE SIZE	....
SINGLE SAMPLING ACCEPTANCE NUMBER	....
SINGLE SAMPLING REJECTION NUMBER	....
DOUBLE SAMPLE SIZE	....
CUMULATIVE DOUBLE SAMPLE SIZE	....
DOUBLE SAMPLING ACCEPTANCE NUMBER	....
DOUBLE SAMPLING REJECTION NUMBER	DATA

Fig.[4.7] : Multiple sampling plan representation

Frame name : S-1/S-2/S-3/S-4/GI/GII/GIII

STARTING VALUE OF LOT SIZE RANGE	DATA
ENDING VALUE OF LOT SIZE RANGE	....
SAMPLE SIZE CODE LETTER	DATA

Fig.[4.8] : Sample size code letters representation

Frame name : LNRI

BEGINNING RANGE OF SAMPLE UNITS	DATA
ENDING RANGE OF SAMPLE UNITS	....
AQL	....
MAX.ALLOWED NUMBER OF DEFECTS	DATA

Fig.[4.9] : Limit numbers for reduced inspection representation

Frame name : M_FILE

INSPECTOR NAME	DATA
DATE OF INSPECTION	....
INSPECTED ITEM	....
LOT NUMBER	....
LOT SIZE	....
SAMPLING PLAN TYPE	....
SAMPLING PLAN INSPECTION LEVEL	....
SAMPLE SIZE CODE	....
AQL	....
SAMPLING PLAN SEVERITY LEVEL	....
SINGLE SAMPLE SIZE	....
SINGLE SAMPLING ACCEPTANCE (AC) NUMBER	....
SINGLE SAMPLING REJECTION (RE) NUMBER	....
DOUBLE SAMPLING FIRST SAMPLE SIZE	....
DOUBLE SAMPLING FIRST SAMPLE AC NUMBER	....
DOUBLE SAMPLING FIRST SAMPLE RE NUMBER	....
DOUBLE SAMPLING SECOND SAMPLE SIZE	....
DOUBLE SAMPLING SECOND SAMPLE AC NUMBER	....
DOUBLE SAMPLING SECOND SAMPLE RE NUMBER	....
MULTIPLE SAMPLING FIRST SAMPLE SIZE	....
MULTIPLE SAMPLING FIRST SAMPLE AC NUMBER	....
MULTIPLE SAMPLING FIRST SAMPLE RE NUMBER	....
.....	....
MULTIPLE SAMPLING SEVENTH SAMPLE SIZE	....
MULTIPLE SAMPLING SEVENTH SAMPLE AC NUMBER	....
MULTIPLE SAMPLING SEVENTH SAMPLE RE NUMBER	....
LOT RESUBMITTED YES/NO	....
TOTAL NUMBER OF DEFECTS	....
LOT ACCEPTED/REJECTED OR INSPECTION TERMINATED	....
TOTAL UNITS INSPECTED	DATA

Fig.[4.10] : Historical data representation

Single sampling plans frames : there are three frames representing single sampling plans for normal (SSPN), reduced (SSPR) and tightened (SSPT) inspection. All three frames have the same structure, but each frame represents one type of a sampling plan. It provides data items that apply to single sampling.

Similarly the double and multiple sampling plans frames represent double and multiple sampling plans for normal (DSPN,MSPN), reduced (DSPR,MSPR) and tightened (DSPT,MSPT) inspection respectively. All three frames have the same structure, but each frame represents one type of a sampling plan. It provides data items that apply to double and multiple sampling respectively.

Limit number for reduced inspection frame : LNRI; it provides data items that are necessary to decide on switching from normal to reduced inspection.

Inspection levels frames : S-1/S-2/S-3/S-4/GI/GII & GIII ; there are seven frames of the same structure, where each frame corresponds to an inspection level. They provide data items which are necessary to determine sample size code letters.

Historical data frame : M_FILE; M_FILE is an empty database. It's structure is copied and a new file is created and named by the user. information on the inspected items are permanently stored here for later reference.

The database structure also contains knowledge items that are not represented by frames. These are production rules that guide the process of selecting certain knowledge items stored

in the frames. Production rules are best described by the use of inference nets.Inference nets are a combination of antecedent-consequent (if-then) rules. Whenever all of the if-then patterns of a rule are satisfied, the rule is triggered and it establishes a new assertion or performs an action (fired).

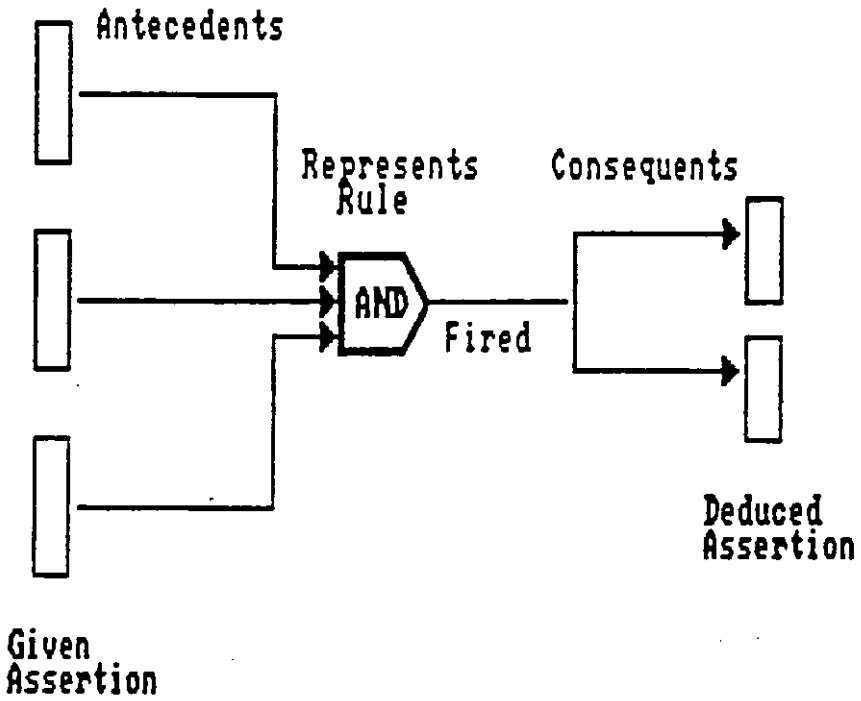


Fig.[4.11] : Inference net (3)

The following inference nets illustrate the production rules which represent the switching procedures employed in the switching process between the different sampling plan's severity levels; normal to reduced, reduced to normal, normal to tightened, tightened to normal and tightened to discontinuation of inspection.

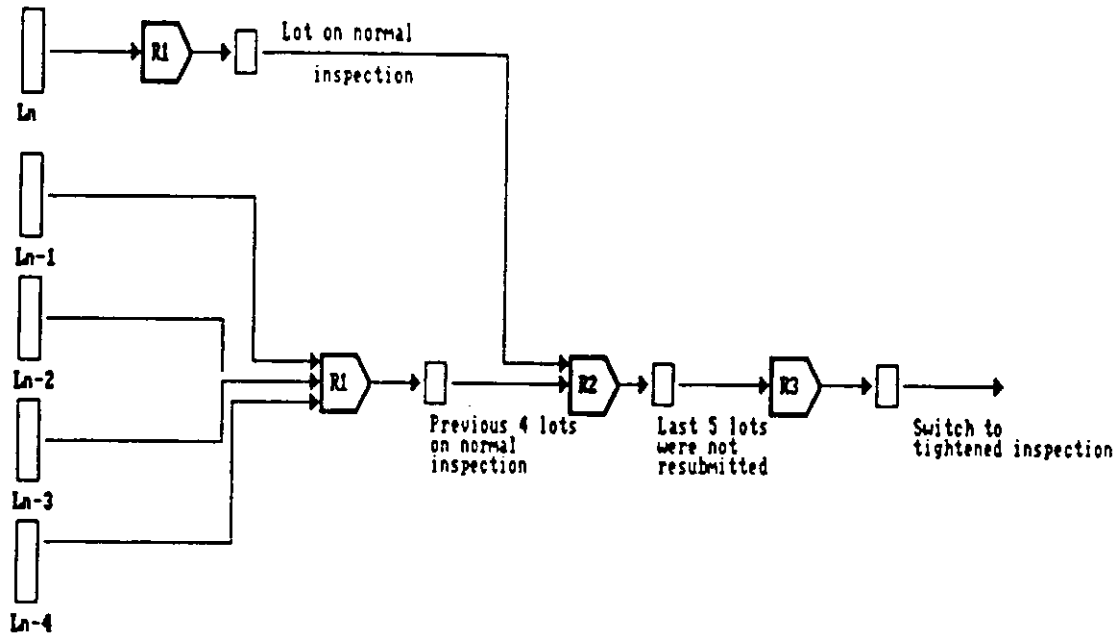


Fig.[4.12]: Switching from Normal to Tightened Inspection

Ln: Last inspected lot.

RULES:

R1: Lot on normal inspection.

R2: Lot was not resubmitted.

R3: 2 out of 5 consecutive lots/batches have been rejected.

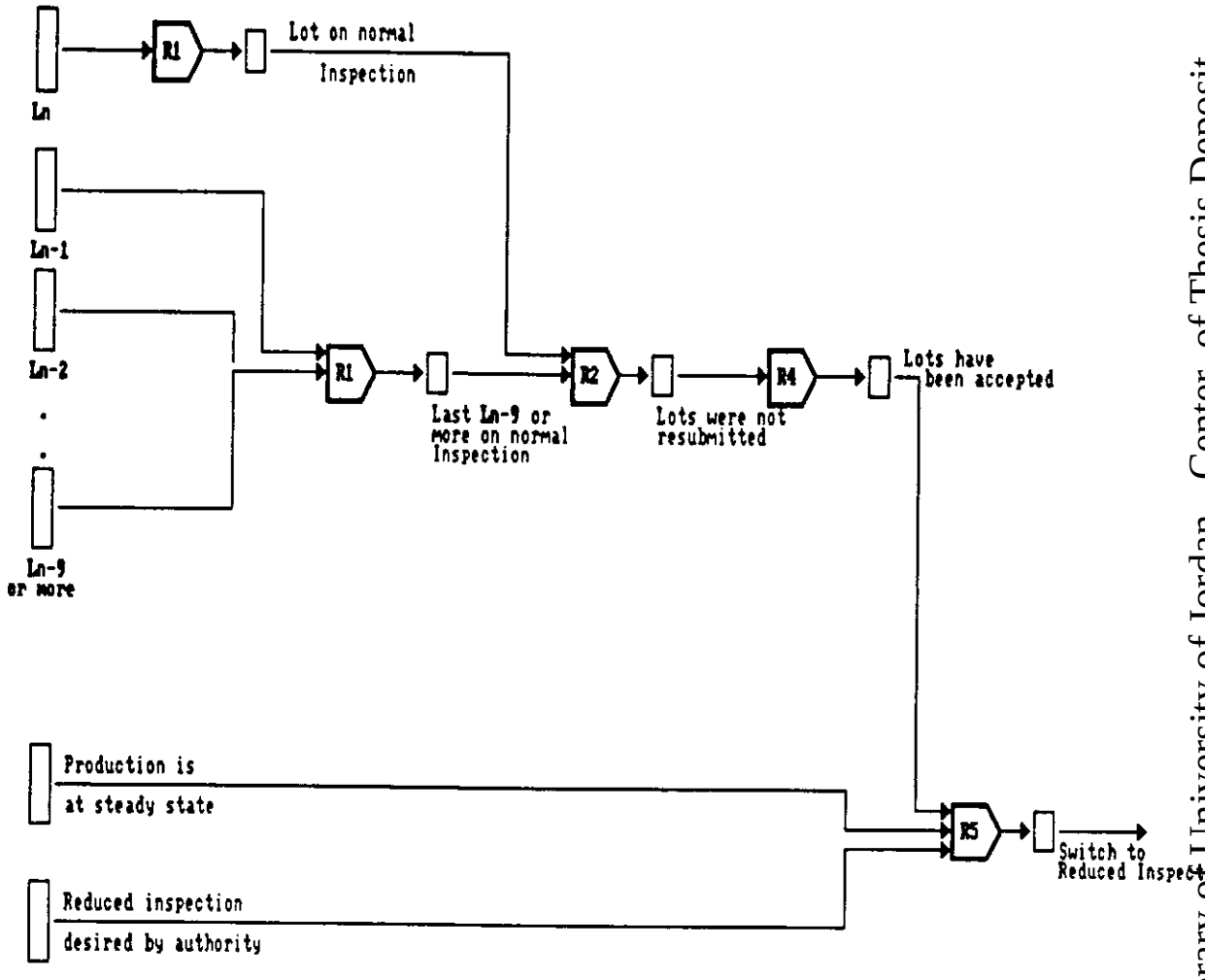


Fig.[4.13]: Switching from Normal to Reduced Inspection

Ln: Last inspected lot.

RULES:

R1: Lot on normal inspection.

R2: Lot was not resubmitted.

R4: Lots have been accepted.

R5: Total No. of defects (defectives) in the samples from preceding lots(= limit number for reduced inspection.

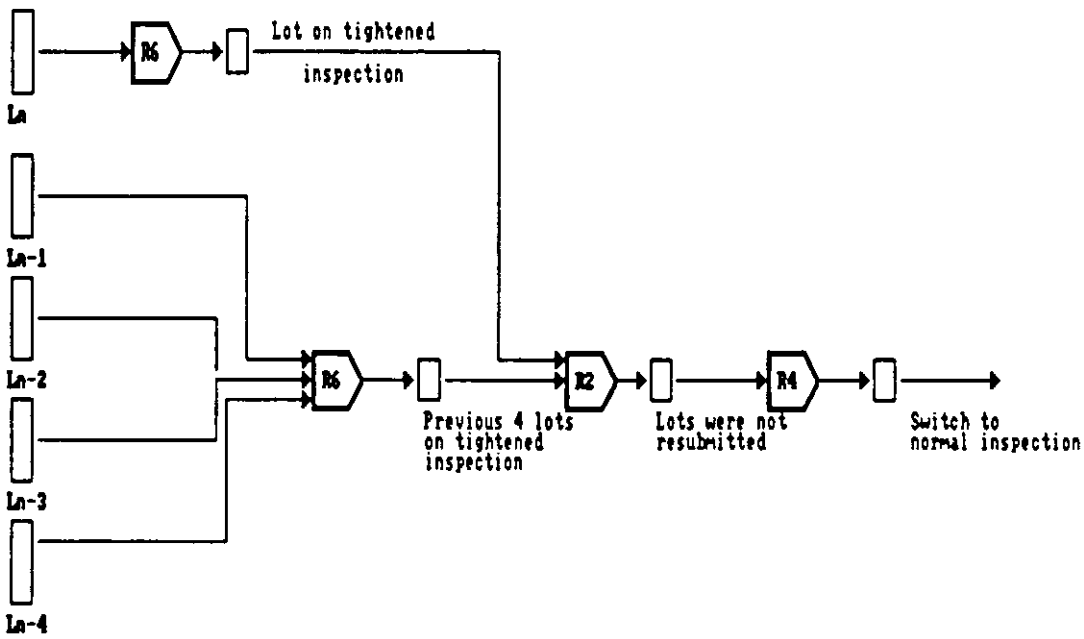


Fig.[4.14]: Switching from Tightened to Normal Inspection

Ln: Last inspected lot.

RULES:

R2: Lot was not resubmitted.

R4: Lots have been accepted.

R6: Lot on tightened inspection.

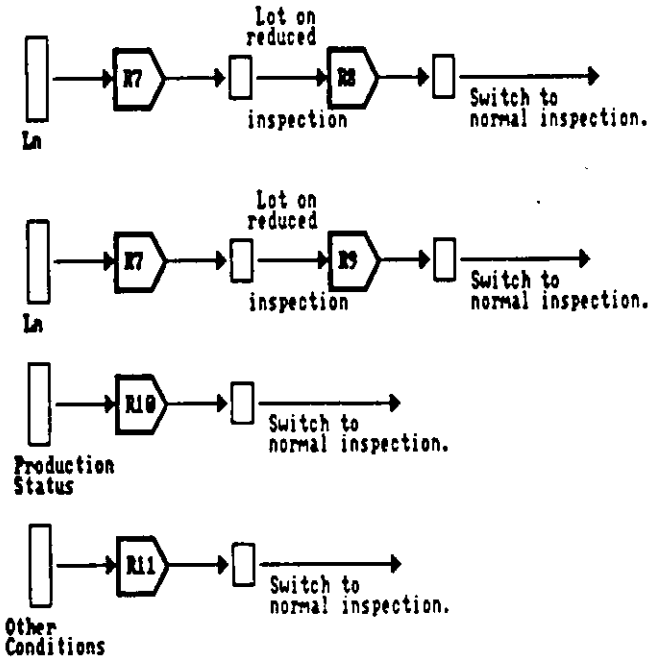


Fig.[4.15]: Switching from Reduced to Normal Inspection

Ln: Last inspected lot.

RULES:

R7: Lot on reduced inspection.

R8: Lot is rejected.

R9: Inspection was terminated.

R10: Production irregular.

R11: Conditions require switching to normal.

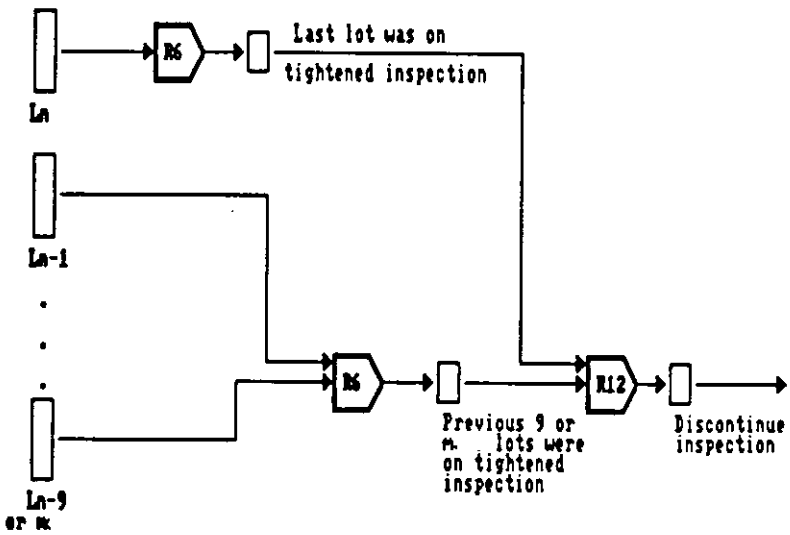


Fig.[4.16]: Discontinuation of Inspection.

Ln: Last inspected lot.

RULES:

R6:Lot on tightened inspection.

R12: 10 consecutive lots/batches (or any number specified by responsible authority) remain on tightened inspection, Inspection will be discontinued.

4.4.5 THE INFERENCE ENGINE

The inference engine contains the mechanisms, strategies and controls used to manipulate and apply knowledge to the problem. It is a group of computer programs that control the whole system processes. In this research, the inference engine have the following structure:

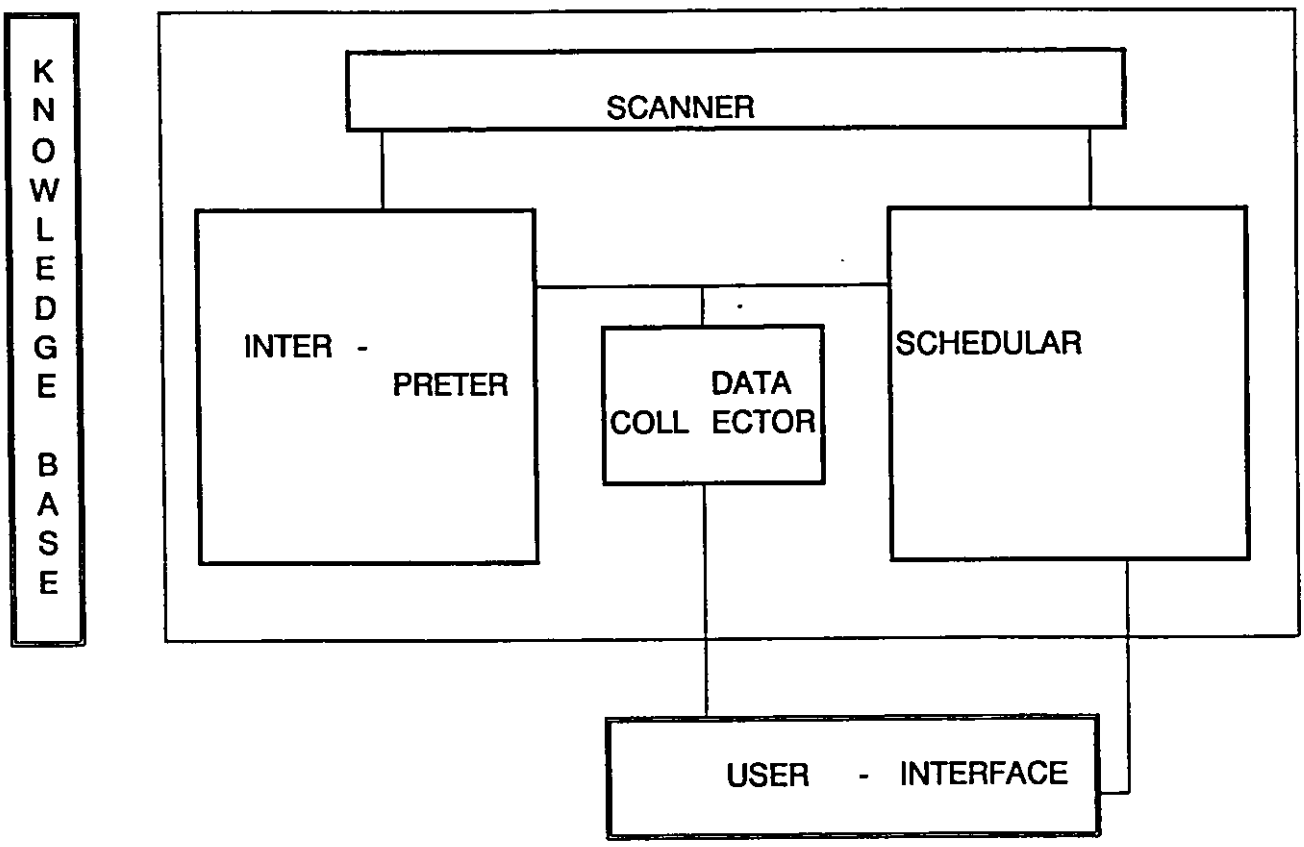


Fig. [4.17] : Inference engine structure (5)

Data collector : it collects data from the user and the databases and stores this data in working memory (memory variables or arrays) for later use. Data is gathered in a user friendly manner using mouse driven menus and input screens through Yes/No questions, push buttons and popup menus.

Schedular : it determines which facts, rules and relationships using either forward or backward chaining. Forward chaining starts with an initial data and proceeds towards the goal state by matching the condition parts of the rules with given data. Where backward chaining starts from the goal state by proposing a hypothesis regarding solving a problem and then works backward to prove this hypothesis by proving the conditions of these rules.

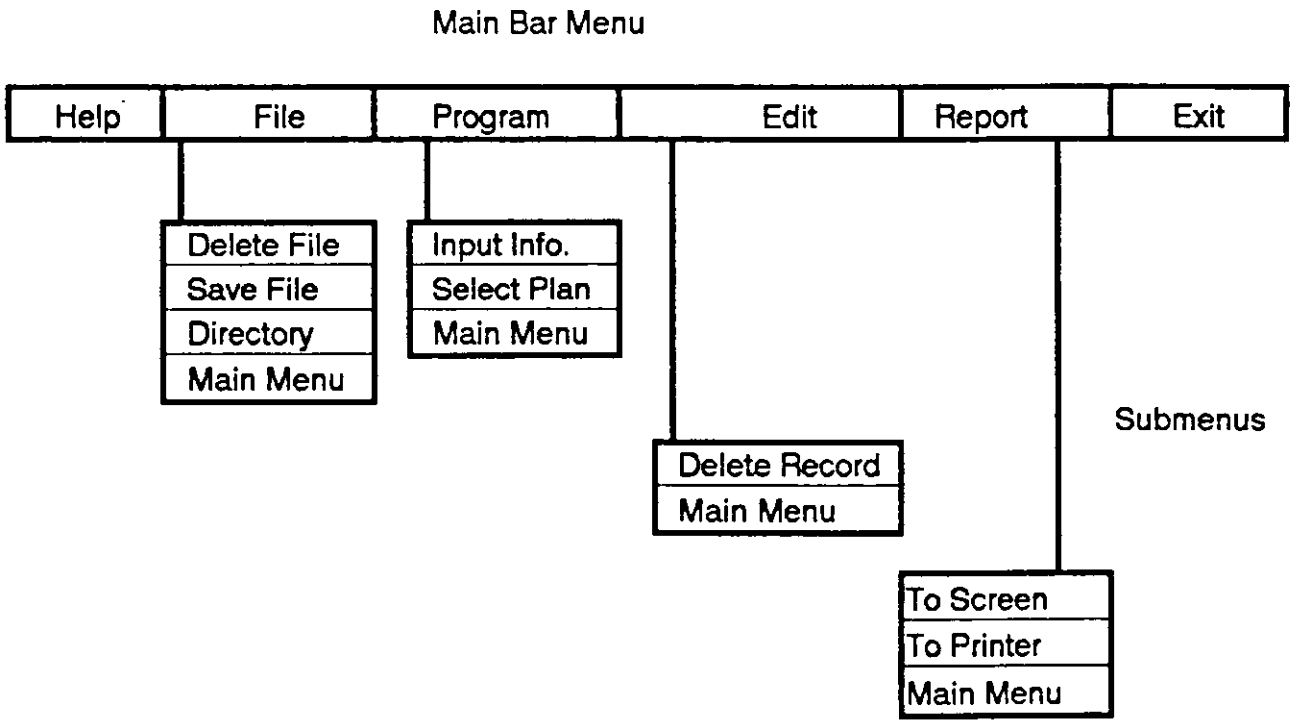
In this research, forward chaining mode was used since all the available data about the problem have been gathered, but we do not really have any good idea about its solution.

Interpreter : it processes the collected data by matching up rules with known facts and carries out actions specified by these rules (e.g. lot size is used to determine the sample size code).

Scanner : This module scans the databases and retrieves the appropriate information

The inference engine's modules are translated to computer programs. Firstly flowcharts are constructed to show the systematic way for solving the problem and to give a clear visual picture of how to select a sampling plan for inspection by attributes using ISO 2859. Having completed the construction of the charts, the information embedded in this charts are translated into program source code.

The following figure and flowcharts display the high level main menu structure and the flowcharts associated with each subproblem.



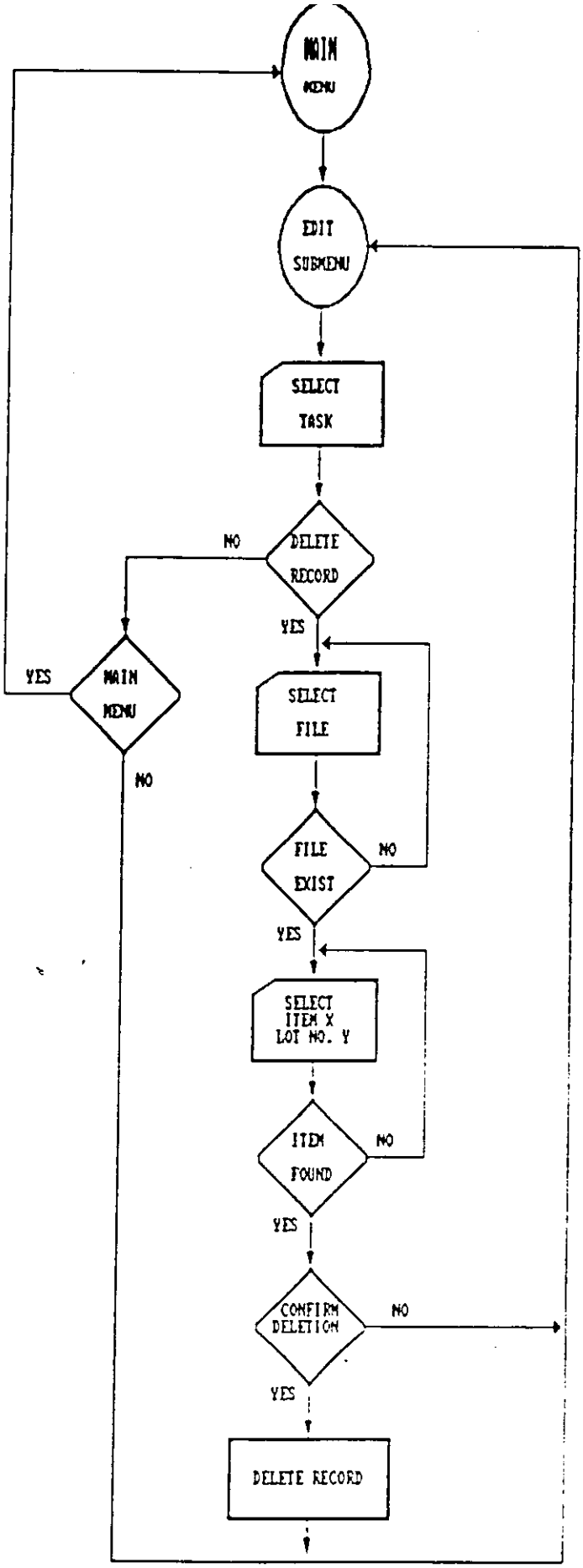


Fig.[4.18]: Edit Submenu Flowchart

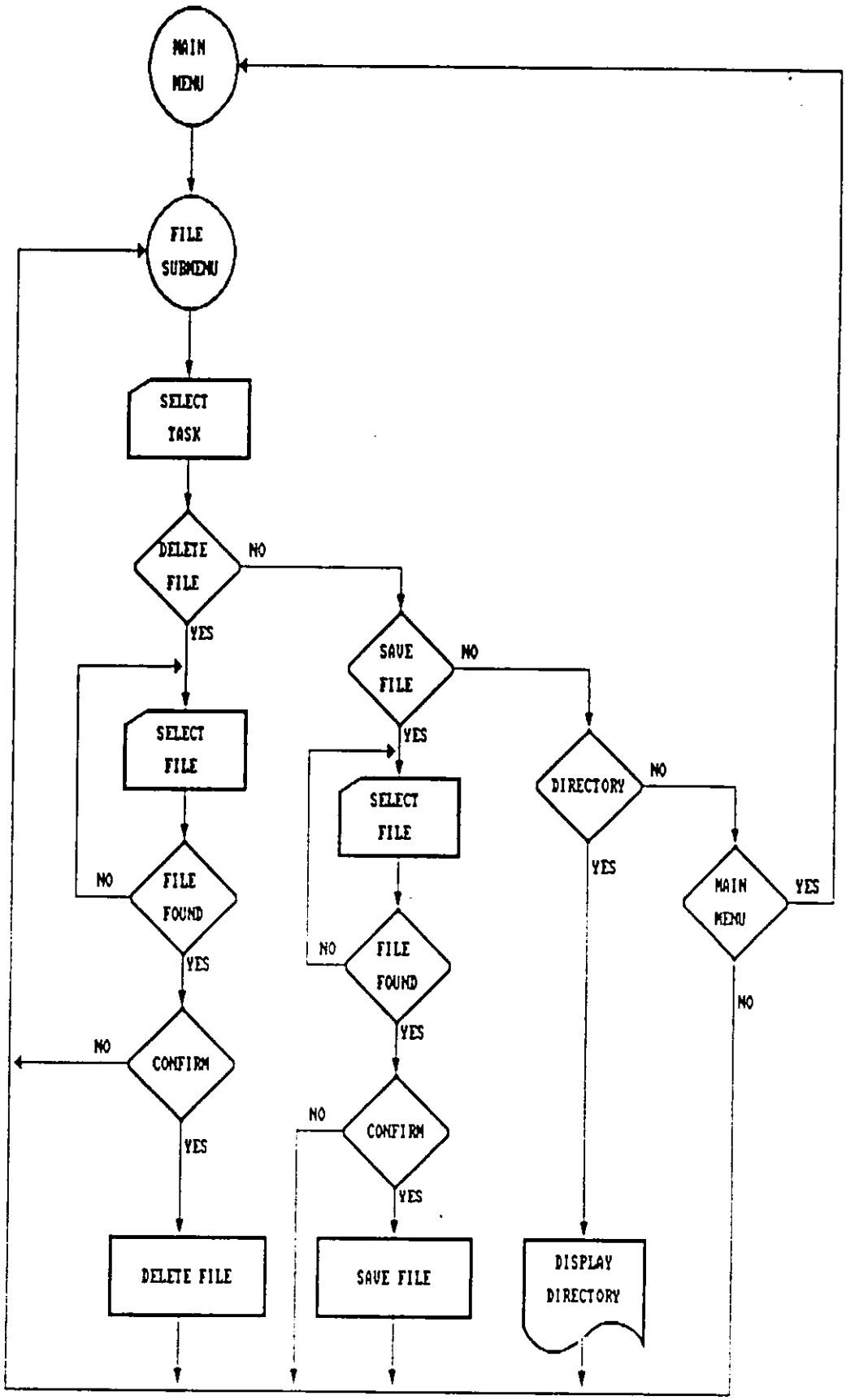


Fig.[4.19]: File Submenu Flowchart

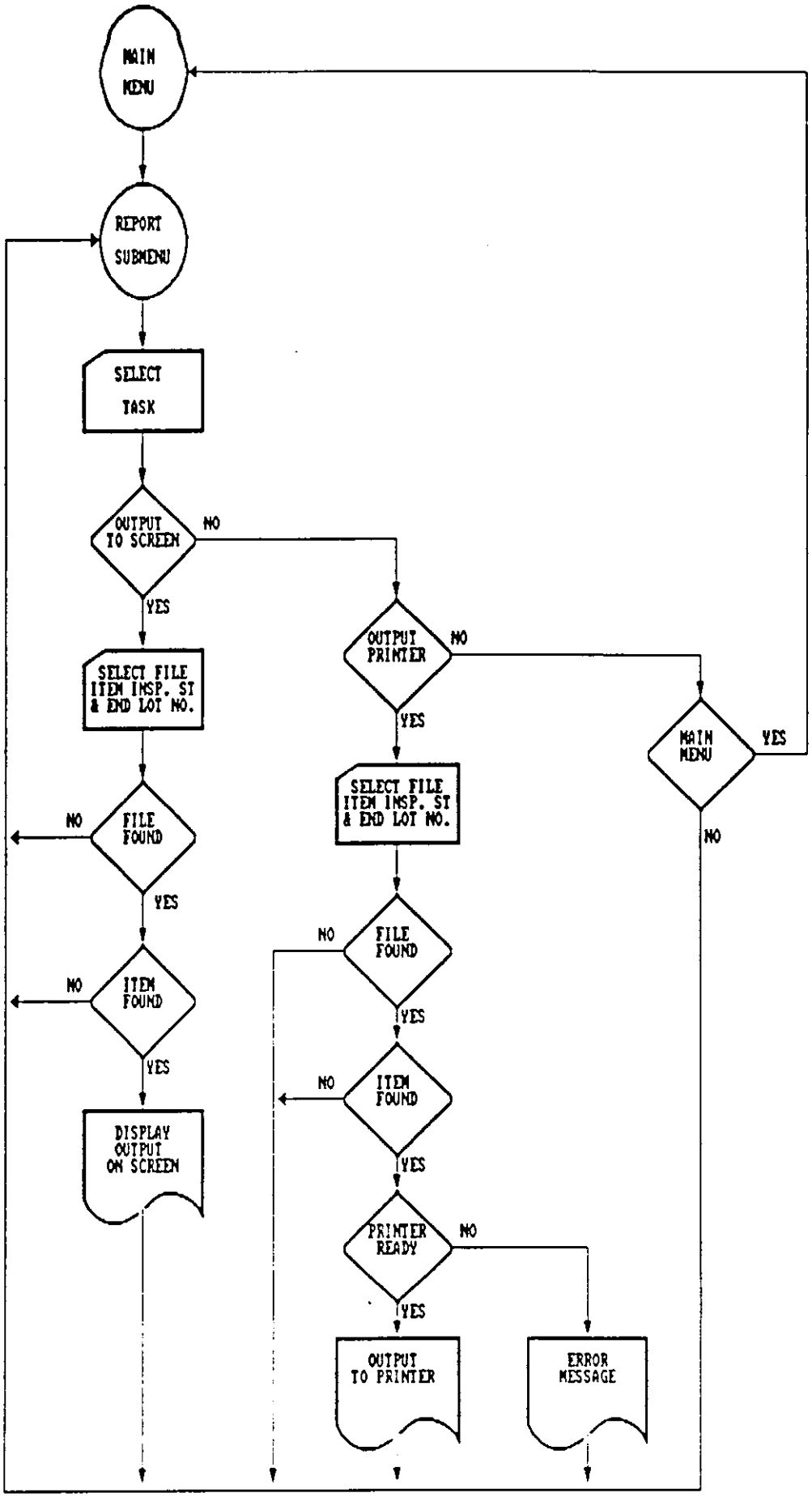


Fig.[4.28]: Report Submenu Flowchart

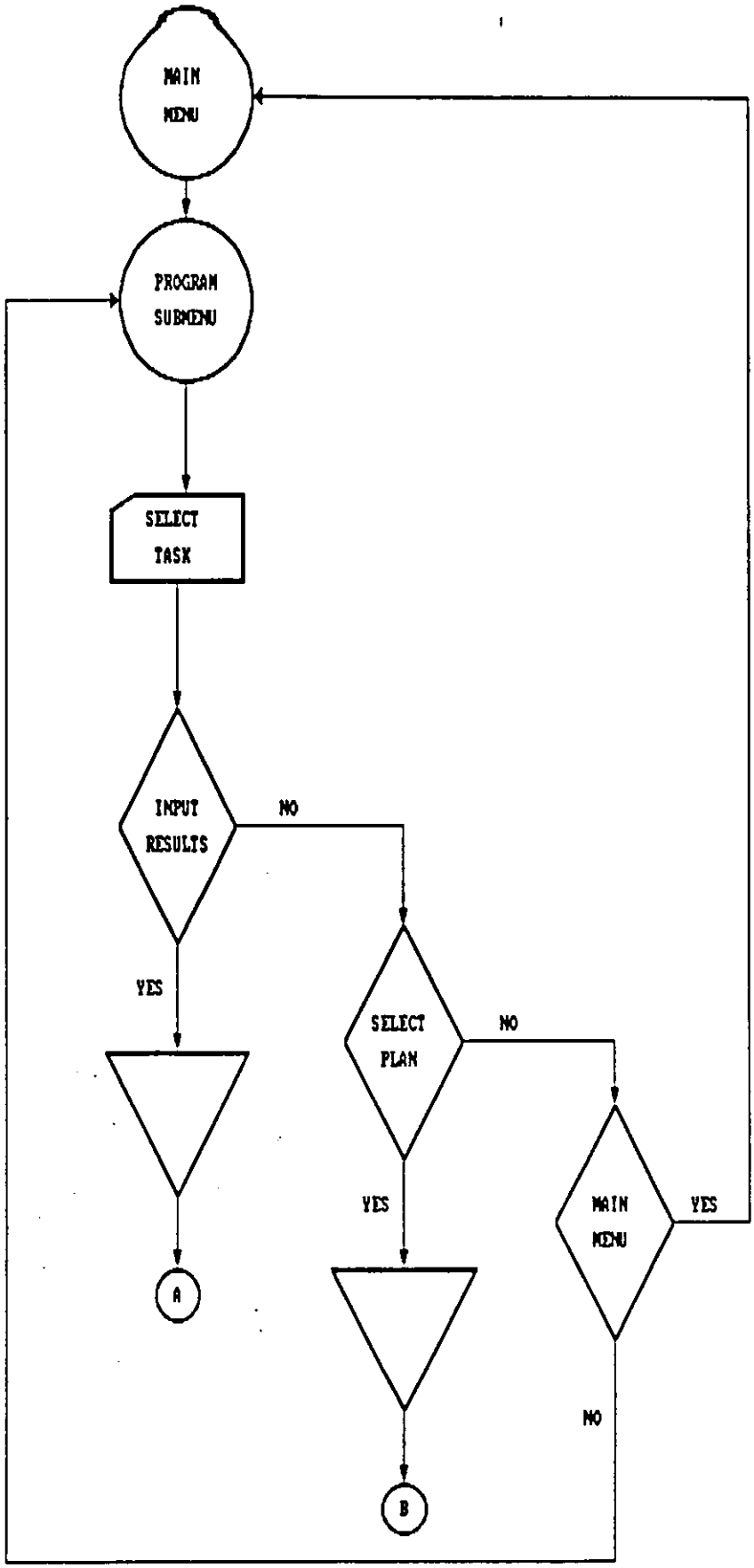
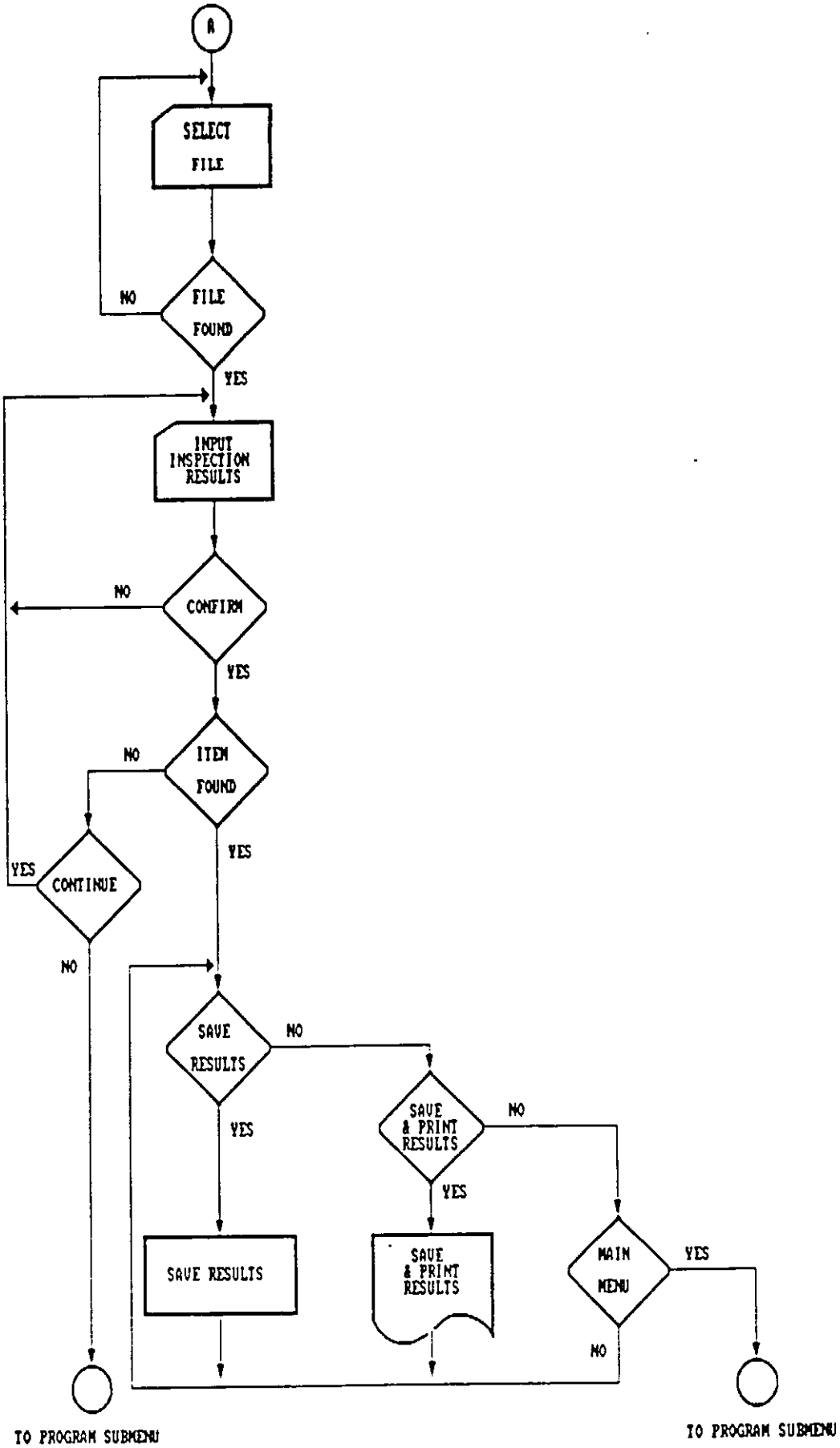
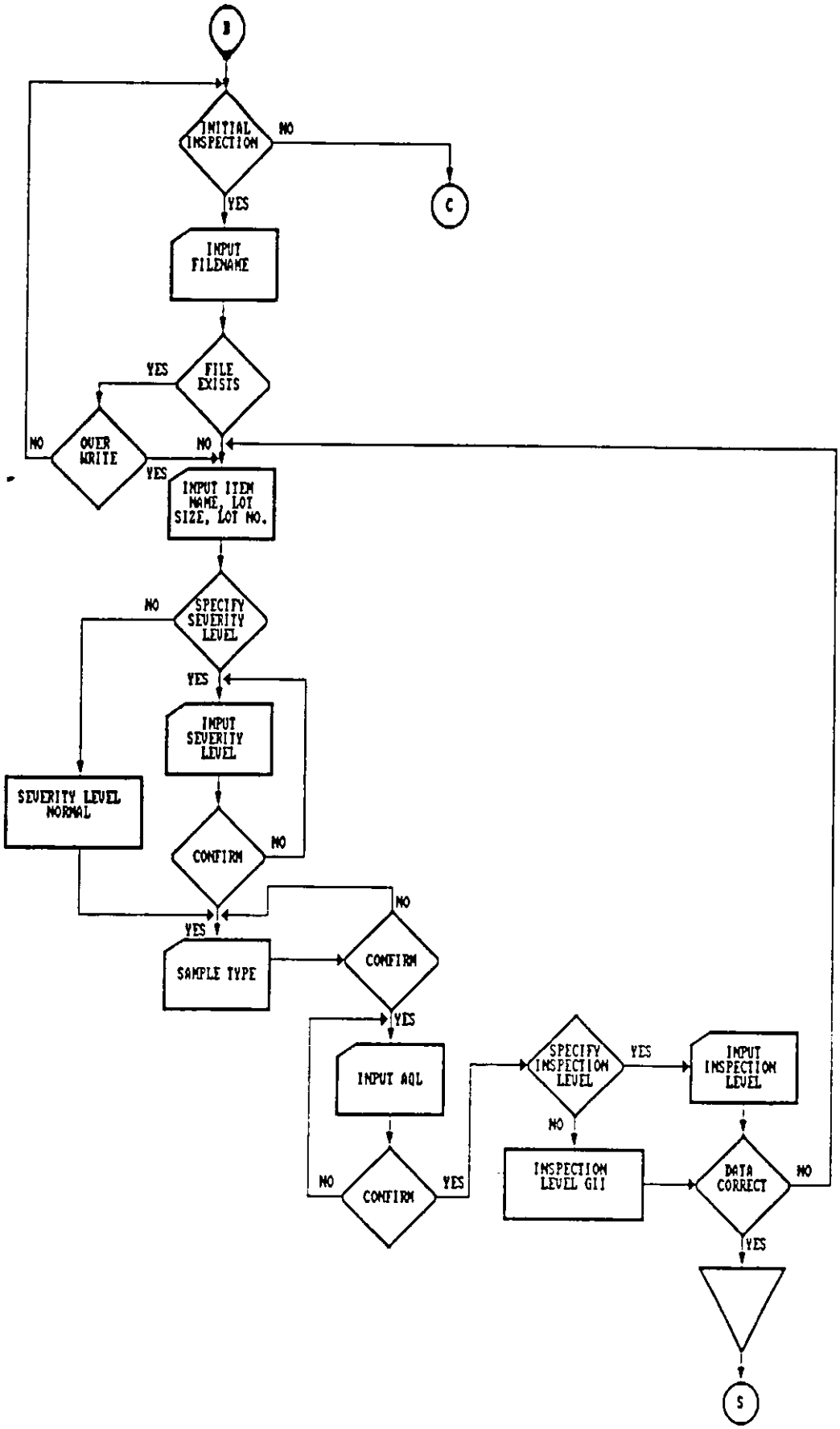
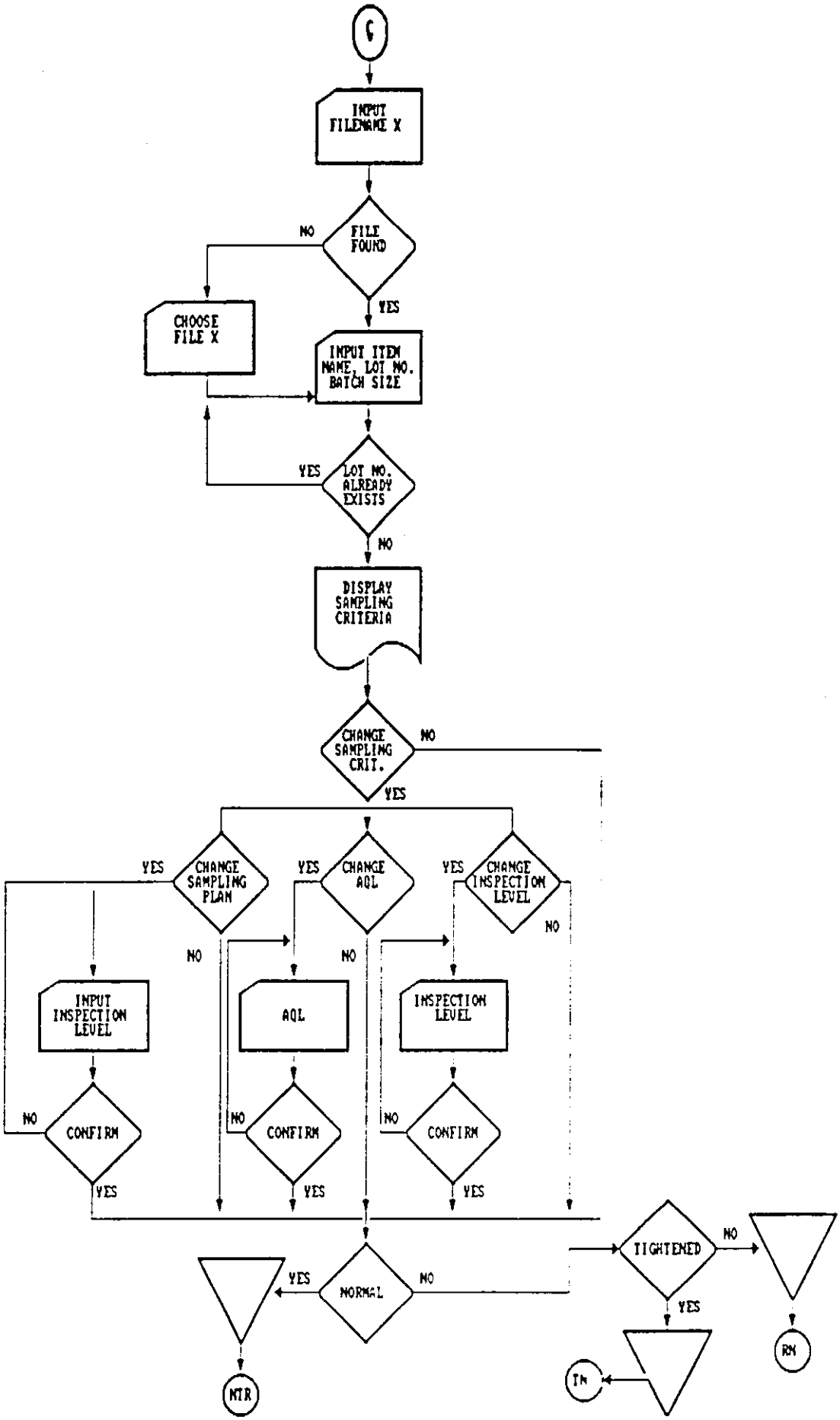
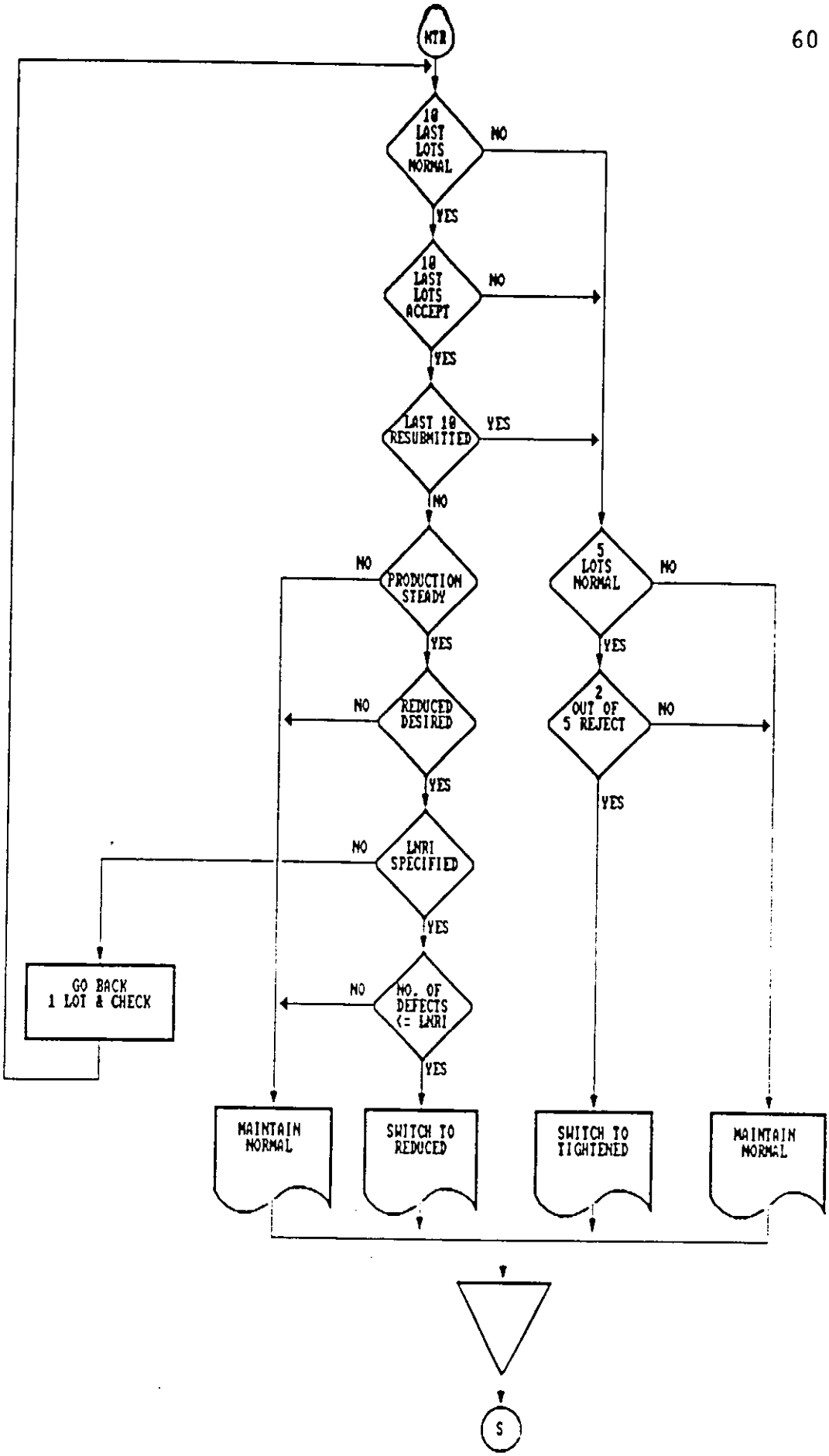


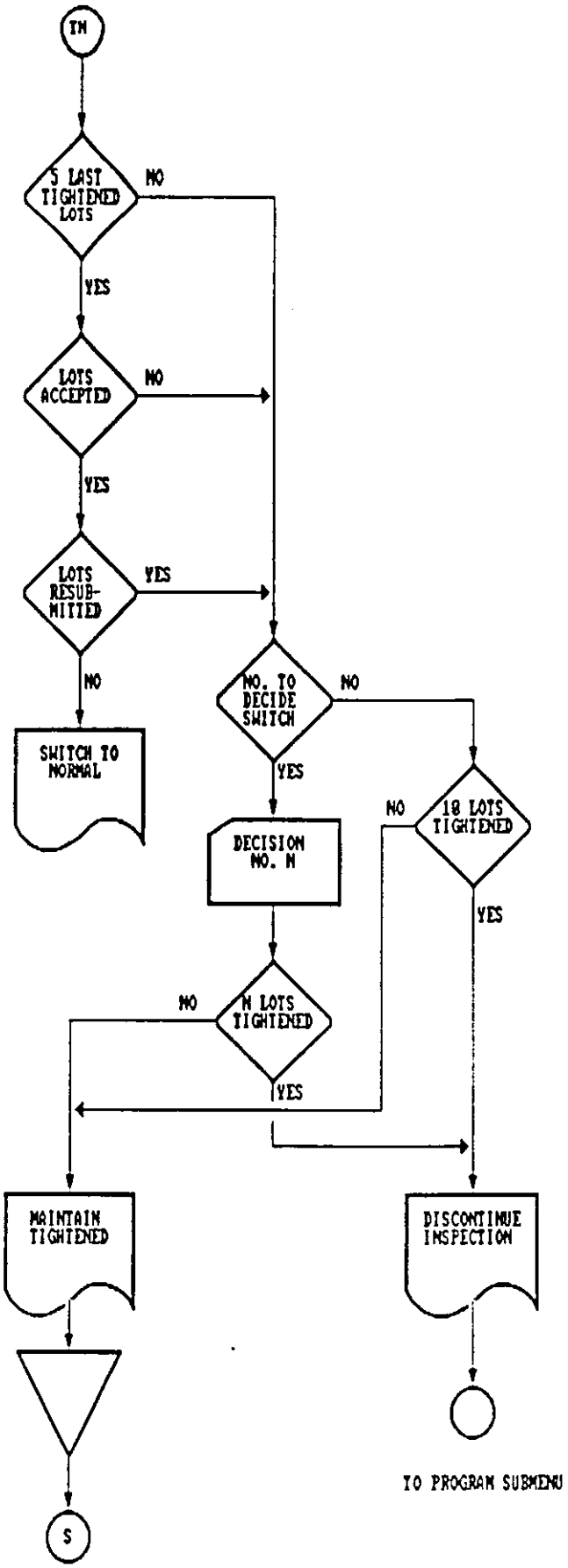
Fig.[4.21]: Program Submenu Flowcharts

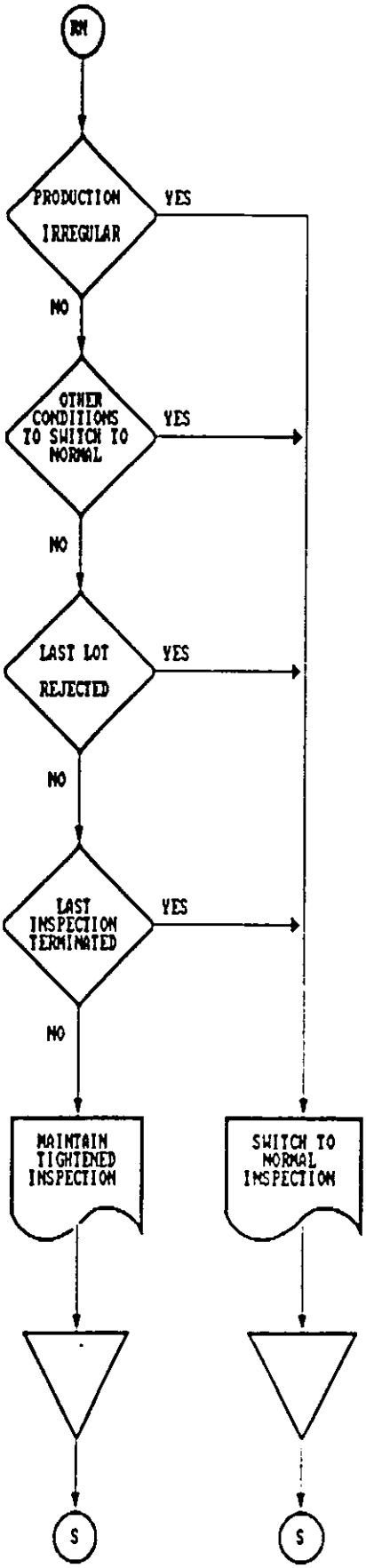


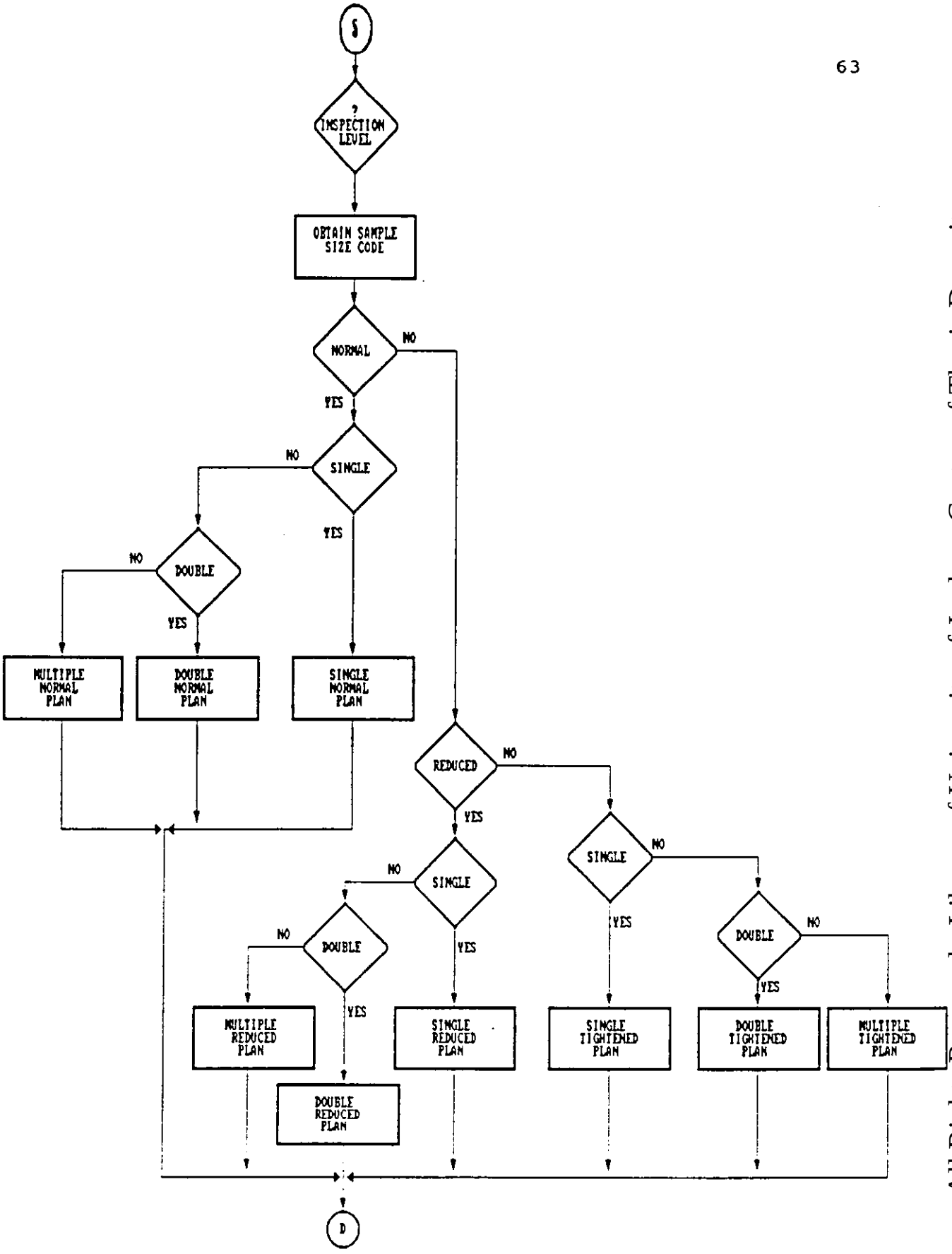


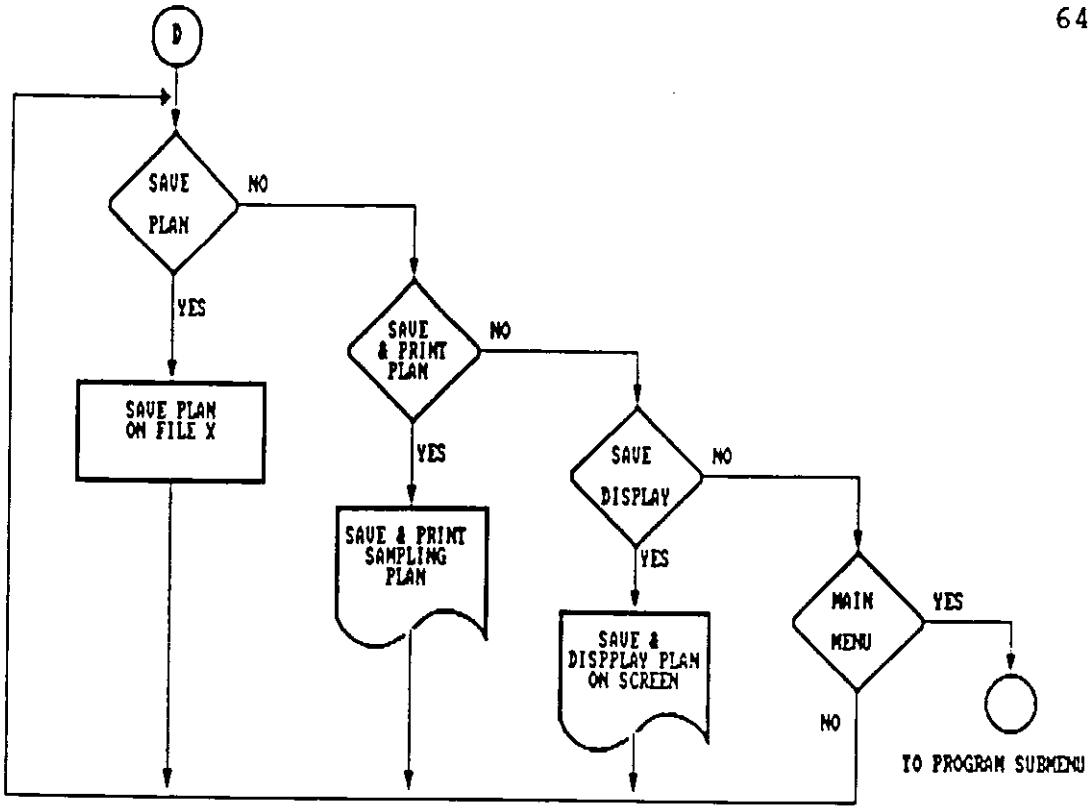












4.5 PHASE 4 SYSTEM DEVELOPMENT

In the system development phase, the great majority of knowledge is added to the system, the user interface is tailored and the system's working performance is monitored and compared to the established benchmarks. The user interfaces must be carefully designed. These interfaces include the actual user interface and the frontend interface. The frontend interface concerns the input, modifications and maintenance capabilities of the system itself. It is how one will get information into the system. This is done using the FoxPro menus and commands. The user interface concerns the methods the end user needs to interact with the system. In this research, the user interface was designed for end users with little or minimal computer know-how. It includes menu-driven control and data input screens featuring help screens and requiring minimal keystrokes. This will be clearer by going through an example in this next chapter.

4.6 PHASE 5 FIELD TESTING

In this phase, the system must be tested in the user environment, again comparing its operation against established benchmarks, modifying and polishing the system until it performs as desired. The expert system is tested and in many different ways and for many different problems. Testing must address the user interfaces and problem areas.

The first step is to check all obvious errors that might occur. From this point, the prototype is checked against the human expert to evaluate performance. Here, any shortcomings in the knowledge base becomes very evident. The most method for performing this task is to give

the same problems to the human expert and to the expert system and then compare the results. The real system under ideal circumstances, should agree with the human expert at least 80 to 90 percent for every problem checked. In our case, the developed expert system must agree 100 percent with the human expert since all the acquired knowledge is 100 percent certain, and the production rules employed in the system are exactly the same rules which will be used by the human expert to reach a decision.

Any major modifications in the system are performed during this phase. The developing-testing loop continues until the expert system performs as expected, meeting the benchmarks.

The developed expert system was tested using many different problems. The selection of the correct sampling plan for inspection by attributes and the switching rules were fully tested, and the overall system performance was checked to make sure that no error shall occur when the system is implemented in the real world.

4.7 PHASE 6 IMPLEMENTATION

In this phase, the expert system is implemented in a real world environment. This may involve porting the system to different hardware, and should include training users and helping them accept the system. This is an important phase since user acceptance can dictate success or failure. An expert system - no matter how good may be - is virtually useless if people will not use it. Unfortunately, our expert system is not yet implemented in a real world environment. Therefore, we can not tell at this point if the system will be accepted or not by the end users.

4.8 PHASE 7 MAINTENANCE

Maintenance, the final phase, is never complete. It continues as long as one uses the system. The system must be continually revised and updated as necessary against benchmarks that dictate new applications or performance improvement.

CHAPTER FIVE

ANALYSIS AND RESULTS

The " Quality Control Expert System For Inspection By Attributes (ISO 2859) " is designed to assist quality inspectors to select sampling plans (sample size n, acceptance number & rejection number) specified by the international standard ISO 2859.

The system utilizes its knowledge base and inference engine to switch between the different sampling plan's severity levels (normal, reduced, tightened or stop inspection) and obtains the correct sampling plan. This is best illustrated by going through an example.

Example : assume that you are a quality engineer, sampling medicine at a pharmaceutical plant to determine the number of defective in a particular medicine or total number of defects in a lot/batch produced by the plant, in order to decide on accepting or rejecting that lot/batch. The lot size varies from one lot to another. You have agreed with the buyer on an AQL value of 1.0. You need to select the sampling plan using the expert system given the following sampling plan criteria :

Acceptable Quality Level (AQL)	: 1.0
Inspection level	: General GII
Sampling plan type	: single
Severity level	: initially normal

The sampling plan type was changed for different system runs to illustrate the three possible sampling plans : single, double and multiple. But, in the real world environment, the sampling plan criteria are not normally changed. Normal inspection is usually initiated and the general inspection level GII is adopted.

For the purpose of this example, hypothetical lot sizes, sampling criteria and inspection results were used. The item under inspection was called Demo and the created historical database was named Demo.dbf.

To run the program type : ***foxprol main***

The program displays the following

QUALITY CONTROL EXPERT SYSTEM
FOR
INSPECTION BY ATTRIBUTES
ISO 2859

SUHAIR KHATIB, UNIVERSITY OF JORDAN
FACULTY OF ENGINEERING & TECHNOLOGY
INDUSTRIAL ENGINEERING DEPARTMENT

COPYRIGHT 1992

From this point, the program is self documenting

Press any key to continue

THIS SOFTWARE PACKAGE ESTABLISHES SAMPLING PLANS FROM THE MILITARY STANDARD MIL-STD 105D (ISO 2859) FOR INSPECTION BY ATTRIBUTES.

A SAMPLING PLAN INDICATES THE NUMBER OF UNITS FROM EACH LOT/BATCH WHICH ARE TO BE INSPECTED (SAMPLE SIZE) AND THE CRITERIA FOR DETERMINING THE ACCEPTABILITY OF THE LOT OR BATCH (ACCEPTANCE & REJECTION NUMBERS).

THE FIRST TIME THE SOFTWARE IS RUN, THE USER MUST INPUT THE VALUE OF THE ACCEPTABLE QUALITY LEVEL (AQL), THE DESIRED SAMPLING PLAN TYPE AND THE INSPECTION LEVEL. NORMAL INSPECTION WILL BE USED AT THE START OF INSPECTION UNLESS OTHERWISE DIRECTED BY AUTHOURITY.

SWITCHING BETWEEN SEVERITY LEVELS WILL BE DONE AUTOMATICALLY AND THE USER WILL BE NOTIFIED WHEN A CHANGE HAS OCCURED.

IT IS POSSIBLE TO CHANGE SAMPLING PLAN CRITERIA DURING PROGRAM EXECUTION. HOWEVER IT IS NOT ADVISABLE TO DO SO.

FOR FURTHER INFORMATION SELECT HELP FROM MAIN MENU

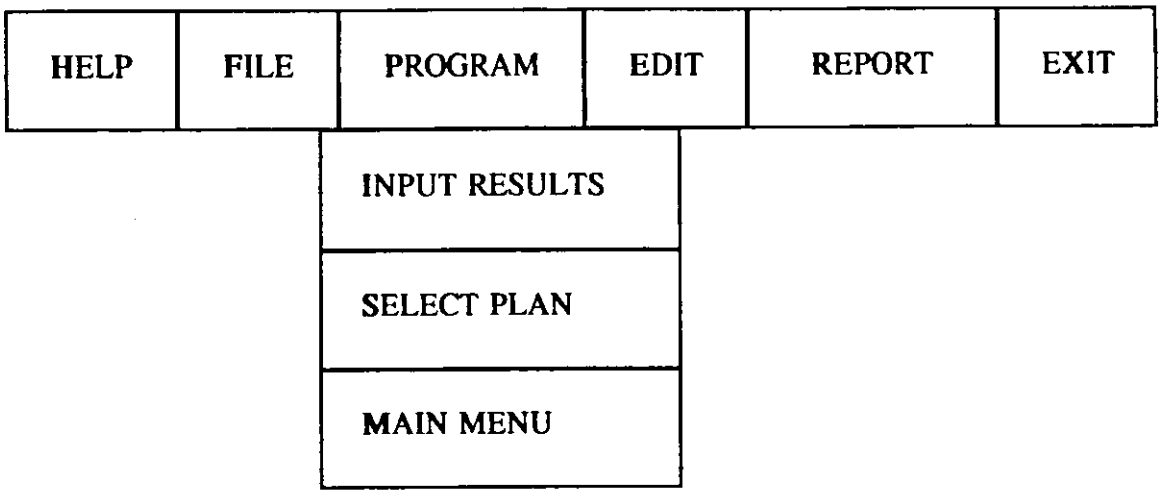
Press any key to continue...

Enter > *P*

HELP	FILE	PROGRAM	EDIT	REPORT	EXIT

MAKE A SELECTION BY PRESSING <ENTER> OR HIGHLIGHTED LETTER

Enter > *S*



Enter > *YES, DEMO*

INPUT SCREEN

IS IT INITIAL INSPECTION ? *YES*

ENTER FILE NAME FOR ITEM INSPECTED : *DEMO*

<< OK >>

Enter > *DEMO, 1, 1250, NO*

INPUT SCREEN

ENTER ITEM INSPECTED NAME : *DEMO*

ENTER LOT NO : *1*

ENTER LOT/BATCH SIZE : *1250*

DO YOU WISH TO SPECIFY SAMPLING PLAN SEVERITY LEVEL:*NO*

<< OK >>

Choose > *SINGLE*

SAMPLING PLAN TYPE SELECTION SCREEN

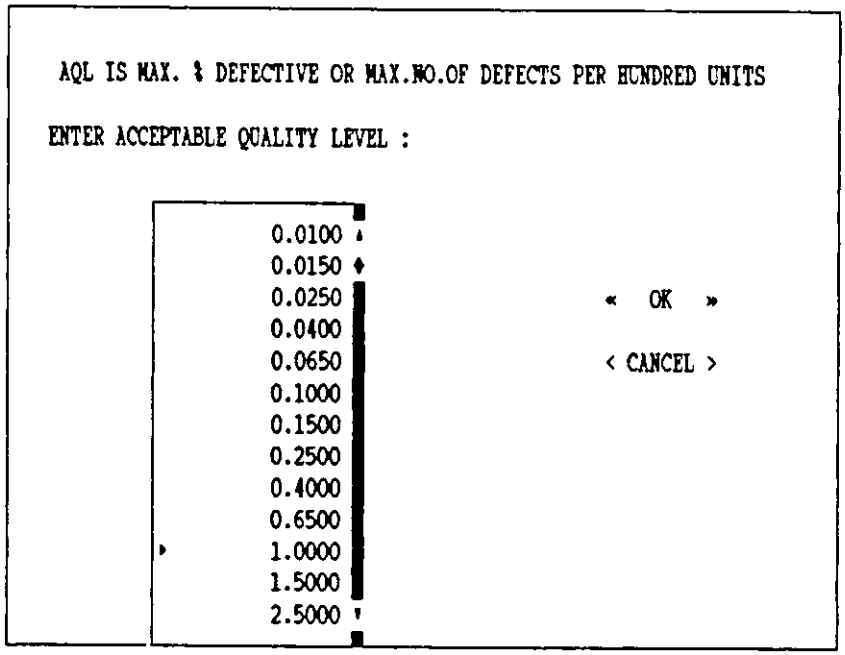
ENTER SAMPLING PLAN TYPE

(•) SINGLE
( ) DOUBLE
( ) MULTIPLE

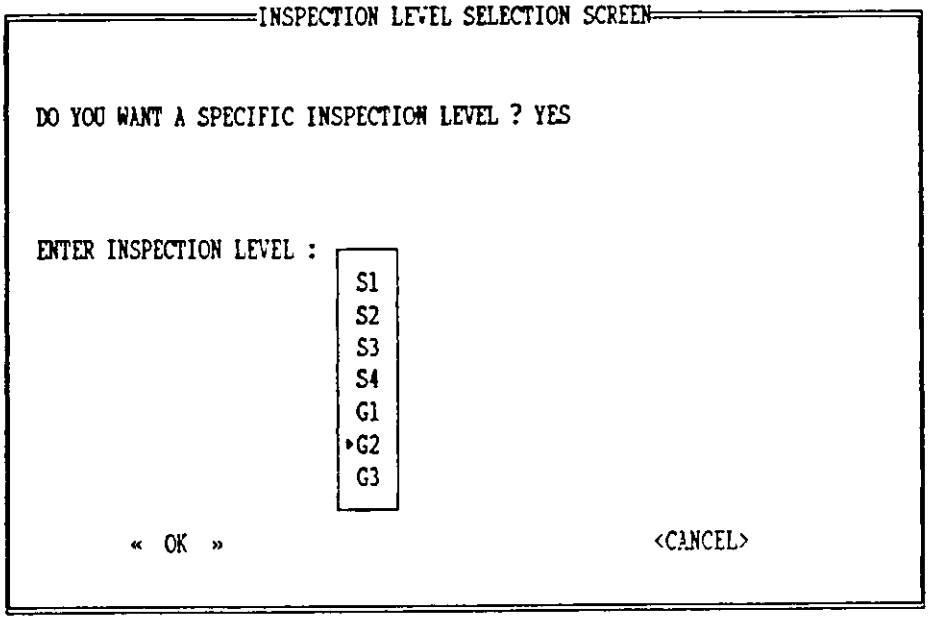
<< OK >> < CANCEL>

Choose > *AQL=1.0*

ACCEPTABLE QUALITY LEVEL SELECTION SCREEN



Enter > *YES*
Choose > *GII*



To check the input results
Press any key to continue

INPUT SCREEN

PRESS ANY KEY TO CONTINUE

ITEM INSPECTED	: *DEMO*
LOT NO	: *1*
LOT/BATCH SIZE	: *1250*
ACCEPTABLE QUALITY LEVEL	: *1.0000*
SAMPLING PLAN TYPE	: *SINGLE*
INSPECTION LEVEL	: *GII*
SEVERITY LEVEL	: *NORMAL*

Enter > *NO*

INPUT SCREEN

DO YOU WISH TO CHANGE INPUT DATA ? *NO*

Enter > *P*

The selected sampling plan will be saved in the file called Demo.dbf, and the sampling plan will be printed out.

SAVE SAMPLING PLAN
SAVE & PRINT SAMPLING PLAN
SAVE & DISPLAY SAMPLING PLAN
MAIN MENU

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 1
LOT/BATCH SIZE: 1250

DATE OF INSPECTION: 05/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED :

TOTAL NUMBER OF DEFECTS :

LOT WAS RESUBMITTED :

LOT ACCEPTED / REJECTED :

Enter > *M*

SAVE SAMPLING PLAN
SAVE & PRINT SAMPLING PLAN
SAVE & DISPLAY SAMPLING PLAN
MAIN MENU

Enter > *I*

HELP	FILE	PROGRAM	EDIT	REPORT	EXIT

INPUT RESULTS
SELECT PLAN
MAIN MENU

Enter > *DEMO*

INPUT SCREEN

ENTER FILE NAME FOR INSPECTED ITEM : *DEMO*

Enter > *DEMO, 1, 05/11/92, SUHAIR, 125, NO, ACCEPT and 2*

INSPECTION INFORMATION INPUT SCREEN

ITEM INSPECTED : *DEMO* INSPECTION DATE (DMY) : *05/11/92*

LOT NO : *1* INSPECTOR NAME : *SUHAIR*

TOTAL SAMPLE SIZE : *125*

WAS THE LOT RESUBMITTED : *NO*

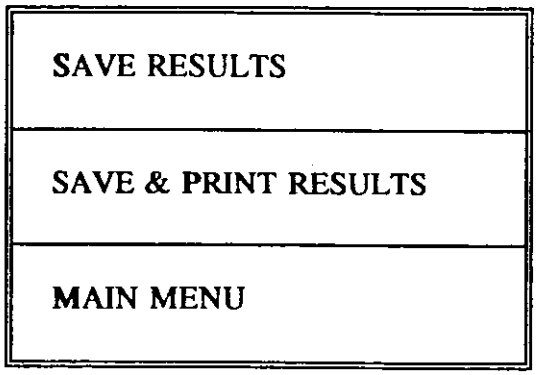
WAS THE LOT AC/RE OR INSPECTION WAS TERMINATED : *ACCEPT*

TOTAL NO. OF DEFECTIVES FOUND DURING INSPECTION : *2*

<< OK >> **< CANCEL >**

Enter > *P*

The inspection results will be saved in the file called Demo.dbf, and a report will be printed out.



INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 1
LOT/BATCH SIZE: 1250

DATE OF INSPECTION: 05/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 2

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

Enter > *M*

SAVE RESULTS
SAVE & PRINT RESULTS
MAIN MENU

Enter > *S*

HELP	FILE	PROGRAM	EDIT	REPORT	EXIT

INPUT RESULTS
SELECT PLAN
MAIN MENU

Enter > *NO, DEMO*

INPUT SCREEN

IS IT INITIAL INSPECTION ? *NO*

ENTER FILE NAME FOR ITEM INSPECTED : *DEMO*

< < OK > >

Enter > *DEMO, 2, 1255*

INPUT SCREEN

ENTER ITEM INSPECTED NAME : *DEMO*

ENTER LOT NO : *2*

ENTER LOT/BATCH SIZE : *1255*

< < OK > >

To check sampling criteria.
Press any key to continue

INPUT SCREEN

PRESS ANY KEY TO CONTINUE

FILE NAME : *D:\QC\DBASE\DEMO.DBF*

ACCEPTABLE QUALITY LEVEL : *1.0000*

SAMPLING PLAN TYPE : *SINGLE*

INSPECTION LEVEL : *GII*

SEVERITY LEVEL : *NORMAL*

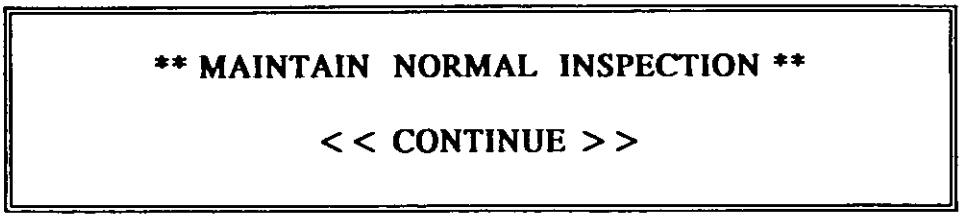
Enter > *NO*

INPUT SCREEN

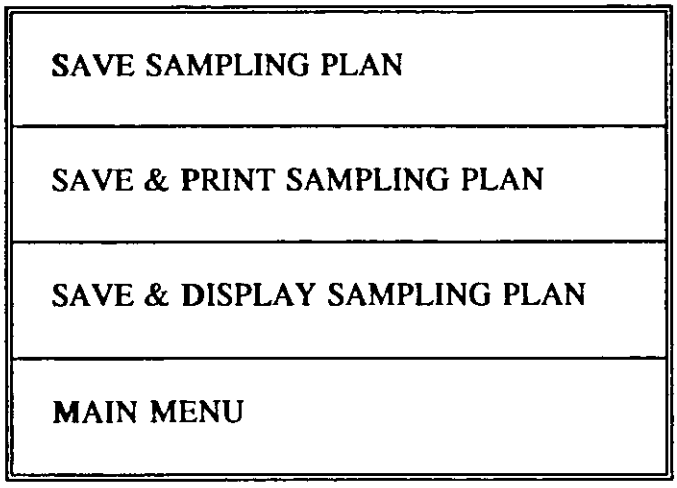
DO YOU WISH TO CHANGE ANY ASPECT OF THE
SAMPLING PLAN ? *NO*

NORMALLY DO NOT CHANGE PLAN ASPECTS UNLESS REQUESTED
BY ADMINISTRATION

Switching rules are examined, a conclusion on the inspection severity level is made and the appropriate sampling plan is selected.



Enter > *S*, then *M*, to return to the main menu.



The system is run for 28 lots to test all the switching rules. The hypothetical lot sizes, sampling criteria and inspection results are as follows :

Table [5.1] : Hypothetical lot sizes, sampling criteria and inspection results.

LOT NO.	LOT SIZE	AQL	PLAN TYPE	INSP. LEVEL	TOTAL UNITS INSPECTED	TOTAL NO. DEFECTS	LOT RESUBMIT	LOT AC / RE	SEVERITY LEVEL	REMARKS
1	1250	1.00	SINGLE	GII	125	2	NO	ACCEPT	NORMAL	START WITH
2	1256	1.00	SINGLE	GII	125	6	NO	REJECT	NORMAL	NORMAL
3	1233	1.00	SINGLE	GII	125	1	NO	ACCEPT	NORMAL	
4	2500	1.00	SINGLE	GII	125	6	NO	REJECT	NORMAL	
5	3000	1.00	SINGLE	GII	125	0	NO	ACCEPT	NORMAL	SWITCH TO
6	3000	1.00	DOUBLE	GII	80	0	NO	ACCEPT	TIGHTENED	TIGHTENED
7	2500	1.00	DOUBLE	GII	160	2	NO	ACCEPT	TIGHTENED	
8	2750	1.00	DOUBLE	GII	80	0	NO	ACCEPT	TIGHTENED	
9	3200	1.00	DOUBLE	GII	160	1	NO	ACCEPT	TIGHTENED	
10	2323	1.00	DOUBLE	GII	160	3	NO	ACCEPT	TIGHTENED	SWITCH TO
11	2500	1.00	DOUBLE	GII	160	3	NO	ACCEPT	NORMAL	NORMAL
12	2000	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
13	2500	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
14	2800	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
15	2500	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
16	2000	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
17	3000	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
18	2300	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
19	2700	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	
20	2345	1.00	DOUBLE	GII	160	0	NO	ACCEPT	NORMAL	SWITCH TO
21	1500	1.00	MULTIPLE	GII	91	9	NO	REJECT	REDUCED	REDUCED
22	1500	1.00	MULTIPLE	GII	32	5	NO	REJECT	NORMAL	
23	1500	1.00	MULTIPLE	GII	96	1	NO	ACCEPT	NORMAL	
24	2500	1.00	MULTIPLE	GII	64	4	NO	REJECT	NORMAL	
25	1650	1.00	MULTIPLE	GII	160	7	NO	REJECT	NORMAL	
26	3000	1.00	MULTIPLE	GII	64	0	NO	ACCEPT	NORMAL	
27	1500	1.00	MULTIPLE	GII	64	0	NO	ACCEPT	TIGHTENED	
IF ONE LOT IS ON TIGHTENED INSPECTION DISCONTINUE INSPECTION.										DISCONTINUE INSPECTION

The output of the expert system is displayed in the output report of Demo.dbf (Appendix A). This is compared against sampling plans obtained by actually looking up the tables in the International standard ISO 2859. The same sampling criteria are adopted and the switching between the different severity levels is done manually by analyzing the assumed collected data on the inspected item, Demo. The output of the expert system agreed 100 percent with the sampling plans which were obtained from the tables for all the example problems.

To obtain a sampling plan using the tables in ISO 2859, one should do the following :

1- knowing the lot size, obtain a code letter from Table I - sample size code letter (Appendix D).

2- knowing the sample size code letter, AQL and the type of sampling, read the sampling plan from one of the nine Master Tables; in our case use Table II- A - single sampling plans for normal inspection (Appendix D).

The following table shows the comparison between the output of the expert system and the human expert.

Table [5.2] : Sampling plan for inspection by attribute

	EXPERT SYSTEM OUTPUT	HUMAN EXPERT OUTPUT
LOT/BATCH SIZE	1250	1250
INSPECTION LEVEL	GII	GII
SAMPLE SIZE CODE	K	K
AQL	1.0	1.0
SEVERITY LEVEL	NORMAL	NORMAL
SAMPLING PLAN TYPE	SINGLE	SINGLE
SAMPLE SIZE	125	125
ACCEPTANCE NUMBER	3	3
REJECTION NUMBER	4	4

The other functions of the expert system such as the Help, Edit, File are explained in the user manual. (Appendix C)

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY AND CONCLUSIONS

This research was directed towards developing an expert system in the field of Quality Control and specifically for inspection by attributes using the International Standard ISO 2859. The approach taken in this research utilized artificial intelligence (AI) concepts and computer programming methodologies.

The final output of this research is an efficient, working expert system software. The specific contributions related to the development of the expert system can be stated as follows :

- The utilization of the expert system as a quality control tool facilitates operational activities for it gives faster response and produces better quality work and documentation.

- The creation and updating of the historical knowledge base and the ease of information retrieval helps the management and concerned employees in an organization (or industrial plant) to evaluate the performance of the organization (or industrial plant) over a time span.

6.2 RECOMMENDATIONS FOR FUTURE RESEARCH

This research focused on the development of an expert system for inspection by attributes using ISO 2859. The results of this research effort may be regarded as a first step towards the development of a larger expert system which will include other aspects of Quality Control.

REFERENCES

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(6) David King, Strategies for integrating decision support, database management, and expert system technology, Export Systems with Applications, Vol. 1, 1990, pp. 23-38

(7) J.M Juran, Frank M. Gryna, RS. Bingham, Quality Control Handbook, Third Edition, McGraw-Hill Book Company.

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For further research, the following are recommended :

- Translating the present expert system to work in the Arabic mode.

- Add new modules to the software to include operating characteristics curves.

- Include other Sampling Procedures for Acceptance Sampling by attributes such as the Dodge-Romig System.

- Include other Sampling Procedures for Acceptance Sampling by variables such as the MIL-STD-414.

(9) Christopher F., Chabris, Artificial Intelligence and Turbo Pascal, Oxford Press, 1987.

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(12) Janusz S. Kowalik, Knowledge Based Problem Solving, Prentice - Hall, New Jersey, U.S.A., 1986.

(13) Jiri Kriz, Knowledge - Based Expert Systems In Industry, Elis Horwood Limited, 1987.

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APPENDIX A

INSPECTION BY ATTRIBUTES REPORT A1

ITEM INSPECTED: DEMO
LOT NUMBER : 1
LOT/BATCH SIZE: 1250

DATE OF INSPECTION: 05/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 2

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 2
LOT/BATCH SIZE: 1255

DATE OF INSPECTION: 06/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 5

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO
LOT NUMBER : 3
LOT/BATCH SIZE: 1233
DATE OF INSPECTION: 07/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL
INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 1

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 4
LOT/BATCH SIZE: 2500

DATE OF INSPECTION: 08/11/92
INSPECTOR : SUHAIR

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 6

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO
LOT NUMBER : 5
LOT/BATCH SIZE: 3000

DATE OF INSPECTION: 10/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : SINGLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	125	125	3	4
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 125

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 6
LOT/BATCH SIZE: 3000

DATE OF INSPECTION: 14/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : TIGHTENED

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	0	3
	SECOND	80	160	3	4
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 80

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO DATE OF INSPECTION: 17/11/92
LOT NUMBER : 7
LOT/BATCH SIZE: 2500 INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE INSPECTION LEVEL : G2
SEVERITY LEVEL : TIGHTENED ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	0	3
	SECOND	80	160	3	4
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 2

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 8
LOT/BATCH SIZE: 2750

DATE OF INSPECTION: 18/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : TIGHTENED

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	0	3
	SECOND	80	160	3	4
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 80

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 9
LOT/BATCH SIZE: 3200

DATE OF INSPECTION: 19/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : TIGHTENED

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	0	3
	SECOND	80	160	3	4
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 1

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 10
LOT/BATCH SIZE: 2323

DATE OF INSPECTION: 20/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : TIGHTENED

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	0	3
	SECOND	80	160	3	4
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 3

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 11
LOT/BATCH SIZE: 2500

DATE OF INSPECTION: 21/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 3

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO DATE OF INSPECTION: 22/11/92
LOT NUMBER : 12
LOT/BATCH SIZE: 2000 INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE INSPECTION LEVEL : G2
SEVERITY LEVEL : NORMAL ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 13
LOT/BATCH SIZE: 2500

DATE OF INSPECTION: 23/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 14
LOT/BATCH SIZE: 2600

DATE OF INSPECTION: 24/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO DATE OF INSPECTION: 25/11/92
LOT NUMBER : 15
LOT/BATCH SIZE: 2500 INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE INSPECTION LEVEL : G2
SEVERITY LEVEL : NORMAL ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 16
LOT/BATCH SIZE: 2000

DATE OF INSPECTION: 26/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 17
LOT/BATCH SIZE: 3000

DATE OF INSPECTION: 27/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 18
LOT/BATCH SIZE: 2300

DATE OF INSPECTION: 28/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 19
LOT/BATCH SIZE: 2700

DATE OF INSPECTION: 29/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 20
LOT/BATCH SIZE: 2345

DATE OF INSPECTION: 30/11/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : DOUBLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	80	80	1	4
	SECOND	80	160	4	5
MULTIPLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
	THIRD	0	0	0	0
	FOURTH	0	0	0	0
	FIFTH	0	0	0	0
	SIXTH	0	0	0	0
	SEVENTH	0	0	0	0

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 21
LOT/BATCH SIZE: 1500
DATE OF INSPECTION: 01/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : REDUCED
INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	13	13	NA	3
	SECOND	13	26	NA	3
	THIRD	13	39	0	4
	FOURTH	13	52	0	5
	FIFTH	13	65	1	6
	SIXTH	13	78	1	6
	SEVENTH	13	91	2	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 91

TOTAL NUMBER OF DEFECTS : 9

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO DATE OF INSPECTION: 02/12/92
LOT NUMBER : 22
LOT/BATCH SIZE: 1500 INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE INSPECTION LEVEL : G2
SEVERITY LEVEL : NORMAL ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	3
	SECOND	32	64	0	3
	THIRD	32	96	1	4
	FOURTH	32	128	2	5
	FIFTH	32	160	3	6
	SIXTH	32	192	4	6
	SEVENTH	32	224	6	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 32

TOTAL NUMBER OF DEFECTS : 5

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO
LOT NUMBER : 23
LOT/BATCH SIZE: 1500

DATE OF INSPECTION: 03/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	3
	SECOND	32	64	0	3
	THIRD	32	96	1	4
	FOURTH	32	128	2	5
	FIFTH	32	160	3	6
	SIXTH	32	192	4	6
	SEVENTH	32	224	6	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 96

TOTAL NUMBER OF DEFECTS : 1

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

ITEM INSPECTED: DEMO
LOT NUMBER : 24
LOT/BATCH SIZE: 2500

DATE OF INSPECTION: 04/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	3
	SECOND	32	64	0	3
	THIRD	32	96	1	4
	FOURTH	32	128	2	5
	FIFTH	32	160	3	6
	SIXTH	32	192	4	6
	SEVENTH	32	224	6	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 64

TOTAL NUMBER OF DEFECTS : 4

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO
LOT NUMBER : 25
LOT/BATCH SIZE: 1650

DATE OF INSPECTION: 05/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	3
	SECOND	32	64	0	3
	THIRD	32	96	1	4
	FOURTH	32	128	2	5
	FIFTH	32	160	3	6
	SIXTH	32	192	4	6
	SEVENTH	32	224	6	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 160

TOTAL NUMBER OF DEFECTS : 7

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : REJECT

ITEM INSPECTED: DEMO
LOT NUMBER : 26
LOT/BATCH SIZE: 3000

DATE OF INSPECTION: 06/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : NORMAL

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	3
	SECOND	32	64	0	3
	THIRD	32	96	1	4
	FOURTH	32	128	2	5
	FIFTH	32	160	3	6
	SIXTH	32	192	4	6
	SEVENTH	32	224	6	7

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 64

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

INSPECTION BY ATTRIBUTES REPORT

ITEM INSPECTED: DEMO
LOT NUMBER : 27
LOT/BATCH SIZE: 1500

DATE OF INSPECTION: 07/12/92
INSPECTOR : SUE

SAMPLING PLAN CRITERIA

SAMPLING PLAN TYPE : MULTIPLE
SEVERITY LEVEL : TIGHTENED

INSPECTION LEVEL : G2
ACCEPTABLE Q.LEVEL: 1.0000

SAMPLING PLAN

PLAN TYPE	SAMPLE	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	AC	RE
SINGLE	FIRST	0	0	0	0
DOUBLE	FIRST	0	0	0	0
	SECOND	0	0	0	0
MULTIPLE	FIRST	32	32	NA	2
	SECOND	32	64	0	3
	THIRD	32	96	0	3
	FOURTH	32	128	1	4
	FIFTH	32	160	2	4
	SIXTH	32	192	3	5
	SEVENTH	32	224	4	5

NOTE : IF ALTERNATIVE PLANS EXIT;CHOOSE EITHER ONE.
AC - ACCEPTANCE NUMBER
RE - REJECTION NUMBER
NA-ACCEPTANCE NOT PERMITTED AT THIS SAMPLE SIZE.

INSPECTION RESULTS

TOTAL UNITS INSPECTED : 64

TOTAL NUMBER OF DEFECTS : 0

LOT WAS RESUBMITTED : NO

LOT ACCEPTED / REJECTED : ACCEPT

APPENDIX B

```
*****************************************************************
*                          MAIN PROGRAM                         *
*****************************************************************
DO SET_ENV
DO FUNCTION

*******************************
*     MEMORY ALLOCATION       *
*******************************
PUBLIC M_SL
PUBLIC M_AQL
PUBLIC M_ST
PUBLIC M_SC
PUBLIC M_IL
PUBLIC M_FN
PUBLIC M_IN
PUBLIC M_LN
PUBLIC M_LS
PUBLIC AQL
PUBLIC IL

PUBLIC M_SZ
PUBLIC M_AC
PUBLIC M_RE

PUBLIC M_DOUB(2,10)
PUBLIC m
PUBLIC M_RECOUNT

PUBLIC M_MULT(7,14)
PUBLIC n

** MEMORY ALLOCATION SEGMENT**


DIMENSION AQL(26)
STORE 0.0100 TO AQL(1)
STORE 0.0150 TO AQL(2)
STORE 0.0250 TO AQL(3)
STORE 0.0400 TO AQL(4)
STORE 0.0650 TO AQL(5)
STORE 0.1000 TO AQL(6)
STORE 0.1500 TO AQL(7)
STORE 0.2500 TO AQL(8)
STORE 0.4000 TO AQL(9)
STORE 0.6500 TO AQL(10)
STORE 1.0000 TO AQL(11)
STORE 1.5000 TO AQL(12)
STORE 2.5000 TO AQL(13)
STORE 4.0000 TO AQL(14)
STORE 6.5000 TO AQL(15)
STORE 10.0000 TO AQL(16)
STORE 15.0000 TO AQL(17)
STORE 25.0000 TO AQL(18)
STORE 40.0000 TO AQL(19)
STORE 65.0000 TO AQL(20)
STORE 100.0000 TO AQL(21)
STORE 150.0000 TO AQL(22)
STORE 250.0000 TO AQL(23)
STORE 400.0000 TO AQL(24)
```

```
STORE 650.0000 TO AQL(25)
STORE 1000.0000 TO AQL(26)

DIMENSION IL(7)
STORE 'S1' TO IL(1)
STORE 'S2' TO IL(2)
STORE 'S3' TO IL(3)
STORE 'S4' TO IL(4)
STORE 'G1' TO IL(5)
STORE 'G2' TO IL(6)
STORE 'G3' TO IL(7)

STORE SPACE(8) TO M_FN
STORE SPACE(10) TO M_IN
STORE 0 TO M_LN
STORE 0 TO M_LS
STORE SPACE(3) TO M_ANS
STORE SPACE(3) TO M_FIRST
STORE SPACE(5) TO M_IL
STORE SPACE(3) TO M_SC
STORE SPACE(9) TO M_SL
STORE SPACE(15) TO M_TEMP
STORE SPACE(8) TO M_ST
STORE 0 TO M_AQL

DEFINE WINDOW PG1 FROM 1,1 TO 23,77;
DOUBLE
ACTIVATE WINDOW PG1
CLEAR

@3,20 SAY'QUALITY CONTROL EXPERT SYSTEM'
@4,33 SAY'FOR'
@5,22 SAY'INSPECTION BY ATTRIBUTES'
@6,30 SAY'ISO 2859'
@14,20 SAY'SUHAIR KHATIB, UNIVERSITY OF JORDAN'
@15,20 SAY'FACULTY OF ENGINEERING & TECHNOLOGY'
@16,21 SAY'INDUSTRIAL ENGINEERING DEPARTMENT'
@19,30 SAY'COPYRIGHT 1992'
WAIT' ' TIMEOUT 2.5
CLEAR WINDOW PG1
CLEAR

DEFINE WINDOW PG2 FROM 1,1 TO 23,77;
DOUBLE
ACTIVATE WINDOW PG2
CLEAR

@1,3 SAY'THIS  SOFTWARE PACKAGE ESTABLISHES SAMPLING PLANS FROM THE MILITARY'
@2,3 SAY'STANDARD  MIL-STD 105D (ISO 2859) FOR INSPECTION BY ATTRIBUTES.'
@4,3 SAY'A  SAMPLING PLAN INDICATES  THE NUMBER OF UNITS FROM EACH LOT/BATCH'
@5,3 SAY'WHICH ARE TO  BE INSPECTED  (SAMPLE SIZE)  AND THE  CRITERIA  FOR'
@6,3 SAY'DETERMINING THE  ACCEPTABILITY  OF THE LOT OR  BATCH  (ACCEPTANCE'
@7,3 SAY'AND REJECTION NUMBERS.)'
@9,3 SAY'THE FIRST TIME THE SOFTWARE IS RUN,  THE USER MUST INPUT THE  VALUE'
@10,3 SAY'OF THE ACCEPTABLE QUALITY LEVEL (AQL),  THE  DESIRED SAMPLING PLAN'
@11,3 SAY'TYPE AND THE INSPECTION LEVEL. NORMAL INSPECTION  WILL BE USED AT'
@12,3 SAY'THE START OF INSPECTION UNLESS OTHERWISE DIRECTED BY THE AUTHORITY.'
@14,3 SAY'SWITCHING BETWEEN SEVERITY LEVELS WILL BE DONE  AUTOMATICALLY  AND'
@15,3 SAY'THE USER WILL BE NOTIFIED WHEN A CHANGE HAS OCCURED.'
@17,3 SAY'IT IS POSSIBLE TO CHANGE SAMPLING PLAN  CRITERIA  DURING  PROGRAM'
```

```
@18,3 SAY'EXECUTION. HOWEVER IT IS NOT ADVISABLE TO DO SO.'          B3
@20,13 SAY' FOR FURTHER INFORMATION SELECT HELP FROM MAIN MENU 'COLOR SCHEME 22
WAIT
CLEAR

CLEAR WINDOW PG2

RESTORE MACROS
ON KEY LABEL SPACEBAR DO DUMMY

SELECT 2
CLEAR WINDOW COMMAND
DEFINE WINDOW MAIN FROM 0,0 TO 26,80 NONE
DEFINE WINDOW INPUT IN MAIN FROM 2,2 TO 18,75;
TITLE'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW MAIN

DEFINE MENU MAIN_POP BAR AT LINE 0  MESSAGE'MAKE A SELECTION BY PRESSING <ENTER
DEFINE PAD HELP OF MAIN_POP PROMPT"\<HELP "
DEFINE PAD FILE OF MAIN_POP PROMPT"\<FILE"
DEFINE PAD PROGRAM OF MAIN_POP PROMPT"\<PROGRAM"
DEFINE PAD EDIT OF MAIN_POP PROMPT"\<EDIT"
DEFINE PAD REPORT OF MAIN_POP PROMPT"\<REPORT"
DEFINE PAD EXIT OF MAIN_POP PROMPT"E\<XIT"

ON SELECTION PAD HELP OF MAIN_POP DO HELP
ON SELECTION PAD FILE OF MAIN_POP DO FILE
ON SELECTION PAD PROGRAM OF MAIN_POP DO PROGRAM
ON SELECTION PAD EDIT OF MAIN_POP DO RECORD
ON SELECTION PAD REPORT OF MAIN_POP DO REPORT
ON SELECTION PAD EXIT OF MAIN_POP DO EXIT

ACTIVATE MENU MAIN_POP
CLEAR WINDOWS
ON KEY
DO FUNCTION
RESTORE MACROS
SET COLOR SET TO DEFAULT

*********************************************************************
PROCEDURE EXIT
*********************************************************************
QUIT



*********************************************************************
PROCEDURE PROGRAM
*********************************************************************

RESTORE MACROS FROM UPDN
DEFINE POPUP PROGRAM RELATIVE SHADOW COLOR SCHEME 4 FROM 1,11
DEFINE BAR 1 OF PROGRAM PROMPT" \<INPUT RESULTS " MESSAGE"INPUT INSPECTION RESU
DEFINE BAR 2 OF PROGRAM PROMPT"---------------"SKIP
DEFINE BAR 3 OF PROGRAM PROMPT" \<SELECT PLAN " MESSAGE" SELECT SAMPLING PLAN"
DEFINE BAR 4 OF PROGRAM PROMPT"---------------"SKIP
DEFINE BAR 5 OF PROGRAM PROMPT" \<MAIN MENU " MESSAGE"RETURN TO MAIN MENU"
ON SELECTION BAR 1 OF PROGRAM DO INF
ON SELECTION BAR 3 OF PROGRAM DO SAMP
ON SELECTION BAR 5 OF PROGRAM  DO QUITP
```

```
ACTIVATE POPUP PROGRAM

RETURN

*********************************************************************
PROCEDURE QUITP
*********************************************************************
DEACTIVATE POPUP PROGRAM
RETURN

*********************************************************************
PROCEDURE QUITR
*********************************************************************
DEACTIVATE POPUP RECORD
RETURN

*********************************************************************
PROCEDURE QUITF
*********************************************************************
DEACTIVATE POPUP FILE
RETURN

*********************************************************************
PROCEDURE QUITO
*********************************************************************
DEACTIVATE POPUP REPORT
RETURN
*********************************************************************
PROCEDURE DUMMY
*********************************************************************
RETURN

*********************************************************************
PROCEDURE FILE
*********************************************************************

RESTORE MACROS FROM UPDN
DEFINE POPUP FILE RELATIVE SHADOW COLOR SCHEME 4 FROM 1,6
DEFINE BAR 1 OF FILE PROMPT" \<DELETE FILE " MESSAGE"DELETE FILE FROM DIRECTORY
DEFINE BAR 2 OF FILE PROMPT"--------------------"SKIP
DEFINE BAR 3 OF FILE PROMPT" \<SAVE FILE ON DISK" MESSAGE"SAVE FILE ON DISK"
DEFINE BAR 4 OF FILE PROMPT"--------------------"SKIP
DEFINE BAR 5 OF FILE PROMPT" DI\<RECTORY" MESSAGE"DISPLAY DATABASE FILES"
DEFINE BAR 6 OF FILE PROMPT"--------------------"SKIP
DEFINE BAR 7 OF FILE PROMPT" \<MAIN MENU" MESSAGE"RETURN TO MAIN MENU"

ON SELECTION BAR 1 OF FILE DO F_DELETE
ON SELECTION BAR 3 OF FILE DO F_SAVE
ON SELECTION BAR 5 OF FILE DO F_DIR
ON SELECTION BAR 7 OF FILE  DO QUITF
ACTIVATE POPUP FILE

RETURN

*********************************************************************
PROCEDURE F_DELETE
*********************************************************************
      HIDE MENU MAIN_POP
      HIDE POPUP FILE
      CLEAR WINDOW MAIN
```

```
      CLOSE ALL
      RESTORE MACROS
      ON KEY
      DO FUNCTION
      STORE SPACE(20) TO M_FN

M_1=.F.
DO WHILE M_1=.F.
      ON ERROR DO ERRHAND
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN1 FROM 2,2 TO 21,79;
      TITLE 'INPUT SCREEN' DOUBLE SHADOW
      ACTIVATE WINDOW WIN1
      CLEAR
      @1,2 SAY'CHOOSE FILE TO DELETE ....'
      @2,2 SAY'INSERT DISK IN CORRECT DRIVE IF FROM DISK DRIVE'
      @16,2 SAY'IF ERROR OCCURS & DRIVE IS NOT READY PRESS <A> TO ABORT OR ';
      COLOR SCHEME 23
      @17,2 SAY'INSERT DISK IN RIGHT DRIVE AND PRESS <R> TO RETRY......'COLOR S
      RESTORE MACROS
      DEFINE POPUP DEL FROM 1,51 TO 13,65 TITLE'FILE' PROMPT FILES LIKE D:\QC\D
      SCROLL SHADOW COLOR SCHEME 15
      ON SELECTION POPUP DEL DEACTIVATE POPUP DEL
      ACTIVATE POPUP DEL

      M_FN=PROMPT()
      M_1=FILE(M_FN)
ENDDO
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN2 FROM 10,15 TO 15,65 DOUBLE SHADOW COLOR SCHEME 24
      ACTIVATE WINDOW WIN2
      @0,4 SAY'ARE YOU SURE YOU WANT TO DELETE THIS FILE '
      @1,15 GET M_FN
   DO KEY1
   STORE 1 TO CHOICE
   @3,1 GET CHOICE PICTURE'@*TH \!CON\<FIRM;\<CANCEL' DEFAULT 1;
   SIZE 1,11,25
   READ CYCLE
   ON KEY
   DO FUNCTION

DO CASE
   CASE CHOICE=1
     CLEAR WINDOW WIN2
     DELETE FILE &M_FN
     CLEAR WINDOW WIN2
     ACTIVATE SCREEN
     CLEAR
     SHOW MENU MAIN_POP

   CASE CHOICE=2
      DEACTIVATE POPUP DIR
      CLEAR WINDOW WIN2
      ACTIVATE SCREEN
      CLEAR
      SHOW MENU MAIN_POP
ENDCASE
RETURN
```

```
*********************************************************************
PROCEDURE F_SAVE
*********************************************************************
      HIDE MENU MAIN_POP
      HIDE POPUP FILE
      CLEAR WINDOW MAIN
      CLOSE ALL
      RESTORE MACROS
      ON KEY
      DO FUNCTION

      STORE SPACE(20) TO M_FN
      STORE SPACE(10) TO M_DEST

M_1=.F.
DO WHILE M_1=.F.
      ON ERROR DO ERRHAND
      DEFINE WINDOW WIN1 FROM 2,2 TO 21,79;
      DOUBLE SHADOW
      ACTIVATE WINDOW WIN1
      CLEAR
      @1,2 SAY'SAVE DATABASE FILE ON DRIVE';
      GET M_DEST
      READ
      @3,2 SAY'" INSERT DISK IN CORRECT DRIVE "'
      @4,2 SAY'  SELECT FILE....'
      @16,2 SAY'IF ERROR OCCURS & DRIVE IS NOT READY PRESS <A> TO ABORT OR ';
      COLOR SCHEME 23
      @17,2 SAY'INSERT DISK IN RIGHT DRIVE AND PRESS <R> TO RETRY......'COLOR S
      DEFINE POPUP DIR FROM 2,45 TO 14,61 TITLE'FILE' PROMPT FILES LIKE D:\QC\D
      SCROLL SHADOW COLOR SCHEME 15
      ON SELECTION POPUP DIR DEACTIVATE POPUP DIR
      ACTIVATE POPUP DIR
      M_FN=PROMPT()
      M_1=FILE(M_FN)
ENDDO
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN2 FROM 10,15 TO 15,65 DOUBLE SHADOW COLOR SCHEME 24
      ACTIVATE WINDOW WIN2
      @0,2 SAY'SAVING FILE ';
      GET M_FN
   DO KEY1
   STORE 1 TO CHOICE
   @3,1 GET CHOICE PICTURE'@*TH \!CON\<FIRM;\<CANCEL' DEFAULT 1;
   SIZE 1,11,25
   READ CYCLE
   ON KEY
   DO FUNCTION

DO CASE
   CASE CHOICE=1
     CLEAR WINDOW WIN2
     USE &M_FN
     TOTAL=HEADER()+RECSIZE()*RECCOUNT()+1
     USE

   DO CASE
      CASE M_DEST='A'
           SET DEFAULT TO A
           IF DISKSPACE() < TOTAL
```

```
            DO D_ERROR
         ENDIF

         IF CHOICE=1
            RUN COPY  &M_FN  A:
         ENDIF

      CASE M_DEST='B'
         SET DEAULT TO B
         IF DISKSPACE() < TOTAL
            DO D_ERROR
         ENDIF

         IF CHOICE=1
            RUN COPY &M_FN  B:
         ENDIF

   ENDCASE

     CLEAR WINDOW WIN2
     SET DEFAULT TO D:\SUE
     ACTIVATE SCREEN
     CLEAR
     SHOW MENU MAIN_POP


   CASE CHOICE=2
      DEACTIVATE POPUP DIR
      CLEAR WINDOW WIN2
      SET DEFAULT TO D:\SUE
      ACTIVATE SCREEN
      CLEAR
      SHOW MENU MAIN_POP
ENDCASE
RETURN

*********************************************************************
PROCEDURE F_DIR
*********************************************************************
HIDE MENU MAIN_POP
HIDE POPUP FILE
CLEAR WINDOW MAIN
CLOSE ALL

DEFINE WINDOW WIN1 FROM 4,10 TO 22,65;
TITLE 'DIRECTORY' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
@16,15 SAY'PRESS ESCAPE [ESC] TO EXIT'COLOR SCHEME 20
DEFINE POPUP F_DIR FROM 1,17 TO 13,32 TITLE'FILE' PROMPT FILES LIKE D:\QC\DBASE
SCROLL SHADOW COLOR SCHEME 15
ACTIVATE POPUP F_DIR
CLEAR WINDOW WIN1
CLEAR
SHOW MENU MAIN_POP


*********************************************************************
PROCEDURE ESCAPE
*********************************************************************
```

```
RETURN

*********************************************************************
PROCEDURE ERRHAND
*********************************************************************
PARAMETER M1,M2
ON ERROR
CLEAR WINDOW WIN1
ACTIVATE SCREEN
CLEAR
RETURN

*********************************************************************
PROCEDURE D_ERROR
*********************************************************************
CLEAR
DEFINE WINDOW S_LEVEL FROM 10,17 TO 15,60 DOUBLE SHADOW COLOR SCHEME 7
ACTIVATE WINDOW S_LEVEL
?CHR(7)
@1,4 SAY'** INSUFFICIENT DISK SPACE **'
@1,4 SAY'INSERT NEW FORMATTED DISK'
DO KEY1
STORE 1 TO CHOICE1
@3,1 GET CHOICE PICTURE'@*TH \!CON\<FIRM;\<CANCEL' DEFAULT 1;
SIZE 1,11,25
READ CYCLE
ON KEY
DO FUNCTION
RETURN

*********************************************************************
PROCEDURE SET_ENV
*********************************************************************
USE
CLOSE ALL
CLEAR ALL
CLEAR
SET DATE TO DMY
SET CONSOLE ON
SET TALK OFF
SET STATUS OFF
SET NOTIFY OFF
SET MENU OFF
SET HELP TO QCHELP
SET BELL ON
SET ESCAPE ON
SET DELETED OFF
SET ECHO OFF
SET SYSMENU OFF
SET MOUSE ON
SET SAFETY OFF
SET COLOR SET TO NEW1
NEWLOCK=CAPSLOCK(.T.)
RETURN

*********************************************************************
PROCEDURE RECORD
*********************************************************************
RESTORE MACROS FROM UPDN
DEFINE POPUP RECORD RELATIVE SHADOW COLOR SCHEME 4 FROM 1,19
```

```
DEFINE BAR 1 OF RECORD PROMPT" \<DELETE RECORD " MESSAGE"DELETE SPECIFIC RECORD
DEFINE BAR 2 OF RECORD PROMPT"---------------"SKIP
DEFINE BAR 3 OF RECORD PROMPT" \<MAIN MENU " MESSAGE"RETURN TO MAIN MENU"
ON SELECTION BAR 1 OF RECORD DO DEL_REC
ON SELECTION BAR 3 OF RECORD DO QUITR
ACTIVATE POPUP RECORD

*****************************************************************
PROCEDURE DEL_REC
*****************************************************************
HIDE MENU MAIN_POP
HIDE POPUP RECORD
CLEAR WINDOWS
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR

STORE SPACE(8) TO M_FN
@1,2 SAY'ENTER FILENAME FOR ITEM INSPECTED  ';
GET M_FN PICTURE '@A,S8'
READ

CLEAR
 M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
 M_1=FILE(M_FN)

DO WHILE M_1=.F.
      ON ERROR DO ERRHAND
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN1 FROM 2,2 TO 21,79;
      TITLE 'INPUT SCREEN' DOUBLE SHADOW
      ACTIVATE WINDOW WIN1
      CLEAR
      ?CHR(7)
      @1,2 SAY'"FILE NOT FOUND !" CHOOSE ANOTHER FILE...'
      @16,2 SAY'IF ERROR OCCURS & DRIVE IS NOT READY PRESS <A> TO ABORT OR ';
      COLOR SCHEME 23
      @17,2 SAY'INSERT DISK IN RIGHT DRIVE AND PRESS <R> TO RETRY......'COLOR S
      RESTORE MACROS
      DEFINE POPUP FILE FROM 1,45 TO 13,60 TITLE'FILE' PROMPT FILES LIKE D:\QC\
      SCROLL SHADOW COLOR SCHEME 15
      ON SELECTION POPUP FILE DEACTIVATE POPUP
      ACTIVATE POPUP FILE

      M_FN=PROMPT()
      M_1=FILE(M_FN)
ENDDO
CLEAR WINDOW WIN1

USE &M_FN

M_FOUND=.F.
DO WHILE M_FOUND=.F.

STORE SPACE(10) TO M_IN
STORE 0 TO M_LN
CLEAR
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
DOUBLE SHADOW
```

```
ACTIVATE WINDOW WIN1
CLEAR

@4,2 SAY'ITEM INSPECTED TO BE DELETED : ';
GET M_IN PICTURE '@S10'
READ

@8,2 SAY'LOT NUMBER TO BE DELETED     : ';
GET M_LN VALID M_LN>0 MESSAGE'LOT NUMBER MUST BE LARGER THAN ZERO'
READ


SET FILTER TO
SET FILTER TO ITEM_INSP=M_IN
LOCATE ALL FOR LOT_NO=M_LN
M_FOUND=FOUND()

IF M_FOUND=.F.

         DEFINE WINDOW S_LEVEL FROM 8,12 TO 15,60 DOUBLE SHADOW COLOR SCHEME 7
         ACTIVATE WINDOW S_LEVEL
         ?CHR(7)
         @0,15 SAY'** WARNING ! **'COLOR SCHEME 20
         @2,4 SAY'** SAMPLED ITEM IS NOT FOUND IN FILE **'
         DO KEY1
         STORE 1 TO CHOICE1
         @5,1 GET CHOICE1 PICTURE'@*TH \!\<CONTINUE;\<CANCEL' DEFAULT CHOICE1;
         SIZE 1,12,20 MESSAGE'CHOOSE <CANCEL> IF YOU WANT TO CANCEL INSPECTION
         READ CYCLE
         ON KEY
         DO FUNCTION

IF CHOICE1=1
   CONTINUE
   CLEAR WINDOWS
   SET FILTER TO
ELSE
    M_FOUND=.T.
    USE
    CLEAR WINDOWS
    ACTIVATE SCREEN
    CLEAR
    SHOW POPUP RECORD
    SHOW MENU MAIN_POP
    CLOSE ALL
    RETURN
ENDIF
ENDIF
ENDDO

      CLEAR WINDOW WIN1
      ACTIVATE SCREEN
      CLEAR
      DEFINE WINDOW WIN2 FROM 10,15 TO 18,65 DOUBLE SHADOW COLOR SCHEME 24
      ACTIVATE WINDOW WIN2
      @0,4 SAY'DELETING ITEM INSPECTED ';
      GET M_IN
      @2,8 SAY'LOT NUMBER          ';
      GET M_LN
   DO KEY1
```

```
   STORE 1 TO CHOICE
   @5,1 GET CHOICE PICTURE'@*TH \!CON\<FIRM:\<CANCEL' DEFAULT 1;
   SIZE 1,11,25
   READ CYCLE
   ON KEY
   DO FUNCTION

DO CASE
   CLEAR WINDOW WIN2
   CASE CHOICE=1
   DELETE RECORD RECNO()
   PACK
   GO BOTTOM
   IF BOF()
      USE
      DELETE FILE &M_FN
   ENDIF
ENDCASE

   CLEAR
   CLEAR WINDOW WIN1
   CLEAR WINDOW WIN2
   CLOSE ALL
   ACTIVATE SCREEN
   CLEAR
   SHOW MENU MAIN_POP
   RETURN

**************************************************************************
PROCEDURE ERRHAND
**************************************************************************
PARAMETER M1,M2
ON ERROR
CLEAR WINDOW WIN1
ACTIVATE SCREEN
CLEAR
RETURN

**************************************************************************
PROCEDURE REPORT
**************************************************************************

RESTORE MACROS FROM UPDN
DEFINE POPUP REPORT RELATIVE SHADOW COLOR SCHEME 4 FROM 1,24
DEFINE BAR 1 OF REPORT PROMPT" TO \<SCREEN " MESSAGE"DISPLAY OUTPUT ON SCREEN"
DEFINE BAR 2 OF REPORT PROMPT"------------"SKIP
DEFINE BAR 3 OF REPORT PROMPT" TO \<PRINTER " MESSAGE"SEND OUTPUT TO PRINTER,SE
DEFINE BAR 4 OF REPORT PROMPT"------------"SKIP
DEFINE BAR 5 OF REPORT PROMPT" \<MAIN MENU" MESSAGE"RETURN TO MAIN MENU"

ON SELECTION BAR 1 OF REPORT DO P_SCREEN
ON SELECTION BAR 3 OF REPORT DO P_PRINTER
ON SELECTION BAR 5 OF REPORT  DO QUITO
ACTIVATE POPUP REPORT

RETURN

**************************************************************************
PROCEDURE P_SCREEN
**************************************************************************
```

```
HIDE MENU MAIN_POP
HIDE POPUP REPORT

STORE SPACE(8) TO M_FN
STORE SPACE(10) TO M_IN
STORE 0 TO B_LN
STORE 0 TO E_LN

DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR

@2,1 SAY'ENTER FILE NAME ' GET M_FN
@5,1 SAY'ENTER ITEM INSPECTED' GET M_IN
@8,1 SAY'ENTER STARTING LOT NUMBER' GET B_LN VALID B_LN>0
@11,1 SAY'ENTER ENDING LOT NUMBER' GET E_LN  VALID E_LN>=B_LN
READ

M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
M_1=FILE(M_FN)

IF M_1=.F.
    WAIT'FILE NOT FOUND, PRESS ANY KEY TO CONTINUE'WINDOW
CLEAR WINDOW WIN1
CLEAR

ELSE
CLEAR WINDOW WIN1
CLEAR

USE &M_FN
GO TOP
SET FILTER TO
SET FILTER TO ITEM_INSP=M_IN
GO BOTTOM
IF BOF()
WAIT'ITEM NOT FOUND, PRESS ANY KEY TO CONTINUE'WINDOW

ELSE
    DEFINE WINDOW REPORTS FROM 1,0 TO 24,79 TITLE'TO VIEW USE [PGUP] [PGDN]——
    ACTIVATE WINDOW REPORTS
    REPORT FORM D_REPORT TO FILE REPORT.TXT FOR BETWEEN(LOT_NO,B_LN,E_LN)
    USE REP
    APPEND MEMO REPORT FROM REPORT.TXT OVERWRITE
    MODIFY MEMO REPORT NOEDIT WINDOW REPORTS
    DEACTIVATE WINDOW REPORTS
ENDIF

SET FILTER TO
USE
ENDIF
CLEAR WINDOWS
SHOW MENU MAIN_POP
SHOW POPUP REPORT
RETURN

*********************************************************************
PROCEDURE P_PRINTER
*********************************************************************
```

```
HIDE MENU MAIN_POP
HIDE POPUP REPORT
STORE SPACE(8) TO M_FN
STORE SPACE(10) TO M_IN
STORE 0 TO B_LN
STORE 0 TO E_LN

DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR

@2,1 SAY'ENTER FILE NAME ' GET M_FN
@5,1 SAY'ENTER ITEM INSPECTED' GET M_IN
@8,1 SAY'ENTER STARTING LOT NUMBER' GET B_LN VALID B_LN>0
@11,1 SAY'ENTER ENDING LOT NUMBER' GET E_LN  VALID E_LN>=B_LN
READ

M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
M_1=FILE(M_FN)

IF M_1=.F.
    WAIT'FILE NOT FOUND, PRESS ANY KEY TO CONTINUE'WINDOW
    CLEAR WINDOW WIN1
    CLEAR

ELSE
CLEAR WINDOW WIN1
CLEAR

USE &M_FN
GO TOP
SET FILTER TO
SET FILTER TO ITEM_INSP=M_IN
GO BOTTOM
IF BOF()
WAIT'ITEM NOT FOUND, PRESS ANY KEY TO CONTINUE'WINDOW

ELSE
GO TOP
IF PRINTSTATUS()
   SET CONSOLE OFF
   SET DEVICE TO PRINTER
   REPORT FORM REPORT TO PRINTER NOEJECT FOR BETWEEN(LOT_NO,B_LN,E_LN)
   SET DEVICE TO SCREEN
   SET CONSOLE ON
ELSE
   WAIT'PRINTER NOT READY ! SET PRINTER ON...' TIMEOUT 2.5
ENDIF
ENDIF
SET FILTER TO
USE
ENDIF
CLEAR WINDOWS
ACTIVATE SCREEN
CLEAR
SHOW MENU MAIN_POP
SHOW POPUP REPORT
RETURN
```

```
**********************
PROCEDURE KEY
**********************
ON KEY LABEL LEFTARROW
ON KEY LABEL RIGHTARROW
RETURN

**********************
PROCEDURE KEY1
**********************
ON KEY LABEL UPARROW
ON KEY LABEL DNARROW
RETURN

**********************
PROCEDURE HELP
**********************
SET HELP ON
SET HELP TO QCHELP
HELP
RETURN

**********************
PROCEDURE FUNCTION
**********************
ON KEY LABEL F1 DO ESCAPE
ON KEY LABEL F2 DO ESCAPE
ON KEY LABEL F3 DO ESCAPE
ON KEY LABEL F4 DO ESCAPE

ON KEY LABEL F5 DO ESCAPE
ON KEY LABEL F6 DO ESCAPE
ON KEY LABEL F7 DO ESCAPE
ON KEY LABEL F8 DO ESCAPE

ON KEY LABEL F9 DO ESCAPE
ON KEY LABEL F10 DO ESCAPE
ON KEY LABEL F11 DO ESCAPE

ON KEY LABEL F12 DO ESCAPE
RETURN
```

```
*************************************************************************
*                      SAMPLING PLAN SELECTION                          *
*************************************************************************   B15

HIDE MENU MAIN_POP
HIDE POPUP PROGRAM
CLEAR WINDOW MAIN
CLOSE ALL
RESTORE MACROS
ON KEY
DO FUNCTION



*****************************
*     MEMORY CLEARING       *
*****************************
STORE SPACE(8) TO M_FN
STORE SPACE(10) TO M_IN
STORE 0 TO M_LN
STORE 0 TO M_LS
STORE SPACE(3) TO M_ANS
STORE SPACE(3) TO M_F1
STORE SPACE(3) TO M_FIRST
STORE SPACE(3) TO INPUT
STORE SPACE(5) TO M_IL
STORE SPACE(3) TO M_SC
STORE SPACE(9) TO M_SL
STORE SPACE(15) TO M_TEMP
STORE SPACE(8) TO M_ST
STORE 0 TO M_AQL

RESTORE MACROS FROM ARROW
CHOICE=2
DO WHILE CHOICE!=1
CLEAR
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
@4,2 SAY'IS IT INTIAL INSPECTION ?';
GET M_FIRST PICTURE '@M YES,NO' MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTION'

STORE SPACE(8) TO M_FN
@8,2 SAY'ENTER FILENAME FOR ITEM INSPECTED  ';
GET M_FN PICTURE '@A,S8'MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'

RESTORE MACROS
   STORE 1 TO CHOICE
   @14,35 GET CHOICE PICTURE'@*T \!\<OK';
   SIZE 1,8,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
   READ CYCLE

DO LINE24

IF UPPER(M_FIRST)='Y'

 M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
 M_1=FILE(M_FN)
```

```
 IF M_1=.T.
    DO F_ERROR
 ENDIF

ENDIF
ENDDO
CLEAR

IF UPPER(M_FIRST)='Y'

   USE M_FILE
   COPY STRUCTURE TO &M_FN
   USE

INPUT=2
DO WHILE INPUT=2

CHOICE=2
DO WHILE CHOICE!=1

ACTIVATE SCREEN
CLEAR
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
RESTORE MACROS FROM ARROW

@2,2 SAY'ENTER ITEM INSPECTED NAME : ';
GET M_IN PICTURE '@S15'

@5,2 SAY'ENTER LOT NO. : ';
GET M_LN MESSAGE' LOT NUMBER MUST BE LARGER THAN ZERO';
VALID M_LN >0

@8,2 SAY'ENTER LOT/BATCH SIZE : ';
GET M_LS MESSAGE'LOT SIZE MUST BE LARGER THAN ONE';
VALID M_LS > 1

M_F1='NO '
@11,2 SAY'DO YOU WISH TO SPECIFY SAMPLING PLAN SEVERITY LEVEL ';
GET M_F1 PICTURE '@M YES,NO' MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTION'

   RESTORE MACROS
   STORE 1 TO CHOICE
   @14,35 GET CHOICE PICTURE'@*T \!\<OK';
   SIZE 1,8,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
   READ CYCLE
DO LINE24
ENDDO

CLEAR WINDOW WIN1
ACTIVATE SCREEN
CLEAR
RESTORE MACROS

** SAMPLING PLAN SEVERITY LEVEL SELECTION **
IF M_F1='NO '
   M_SL='NORMAL'
```

```
ELSE

DEFINE WINDOW WIN2 FROM 2,2 TO 20,79;
TITLE 'SAMPLING PLAN SEVERITY LEVEL SELECTION SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN2

STORE 2 TO CHOICE
STORE 1 TO CHOICE1

DO WHILE CHOICE=2
   DO KEY
   CLEAR
   @4,25 SAY 'ENTER SAMPLING PLAN SEVERITY LEVEL'
   @7,30 GET CHOICE1 FUNCTION '*RT \<NORMAL;\<REDUCED;\<TIGHTENED' DEFAULT 1 SI
   MESSAGE'SCROLL FOR DIFFERENT OPTIONS' COLOR SCHEME 14
   READ CYCLE
   ON KEY
   DO FUNCTION
   DO KEY1
   STORE 1 TO CHOICE
   @15,15 GET CHOICE PICTURE'@*TH \!\<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,10,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
   READ CYCLE
   ON KEY
   DO FUNCTION
ENDDO

   DO CASE
      CASE CHOICE1=1
      M_SL='NORMAL'
      CASE CHOICE1=2
      M_SL='REDUCED'
      CASE CHOICE1=3
      M_SL='TIGHTENED'
   ENDCASE
ENDIF


** SAMPLING PLAN TYPE SINGLE/DOUBLE/MULTIPLE **

DEFINE WINDOW WIN2 FROM 2,2 TO 20,79;
TITLE 'SAMPLING PLAN TYPE SELECTION SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN2

STORE 2 TO CHOICE
STORE 1 TO CHOICE1

DO WHILE CHOICE=2
   DO KEY
   CLEAR
   @4,25 SAY 'ENTER SAMPLING PLAN TYPE'
   @7,30 GET CHOICE1 FUNCTION '*RT \<SINGLE;\<DOUBLE;\<MULTIPLE' DEFAULT 1 SIZE
   MESSAGE'SCROLL FOR DIFFERENT OPTIONS' COLOR SCHEME 14
   READ CYCLE
   ON KEY
   DO FUNCTION
   DO KEY1
   STORE 1 TO CHOICE
   @15,15 GET CHOICE PICTURE'@*TH \!\<OK;\<CANCEL' DEFAULT 1;
```

```
   SIZE 1,10,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
   READ CYCLE
   ON KEY
   DO FUNCTION
ENDDO

   DO CASE
      CASE CHOICE1=1
      M_ST='SINGLE'
      CASE CHOICE1=2
      M_ST='DOUBLE'
      CASE CHOICE1=3
      M_ST='MULTIPLE'
   ENDCASE


STORE 2 TO CHOICE
DO WHILE CHOICE=2

   CLEAR WINDOW WIN2
   ACTIVATE SCREEN
   CLEAR

   @2,18 SAY'ACCEPTABLE QUALITY LEVEL SELECTION SCREEN' FUNCTION'I';
   COLOR SCHEME 14
   @6,6 SAY' AQL IS MAX. % DEFECTIVE OR MAX.NO.OF DEFECTS PER HUNDRED UNITS ' C
   @4,2 TO 25,75 COLOR SCHEME 14
   STORE 11 TO i
   @8,6 SAY 'ENTER ACCEPTABLE QUALITY LEVEL :'
   @10,15 GET i FROM AQL DEFAULT 11 COLOR SCHEME 15

   DO KEY1
   STORE 1 TO CHOICE
   @13,55 GET CHOICE PICTURE'@*TV  \! \<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,10,1
   READ CYCLE
   ON KEY
   DO FUNCTION

ENDDO
    CLEAR READ
    STORE AQL(i) TO M_AQL


   CLEAR WINDOW WIN3
   ACTIVATE SCREEN
   CLEAR


** SPECIFIC INSPECTION LEVER S1/S2/S3/S4/G1/G2/G3 **

   DEFINE WINDOW WIN2 FROM 2,2 TO 20,79;
   TITLE 'INSPECTION LEVEL SELECTION SCREEN' DOUBLE SHADOW
   ACTIVATE WINDOW WIN2

   @2,2 SAY 'DO YOU WANT A SPECIFIC INSPECTION LEVEL ?';
   GET M_ANS PICTURE '@M/< YES,NO' MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTI
   READ
```

```
    DO CASE
        CASE UPPER(M_ANS)='Y'

        STORE 2 TO CHOICE
        DO WHILE CHOICE=2
        STORE 6 TO i
   @6,2 SAY 'ENTER INSPECTION LEVEL :';
   GET i FROM IL DEFAULT 6 COLOR SCHEME 15
   DO KEY1
   STORE 1 TO CHOICE
   @15,10 GET CHOICE PICTURE'@*TH \! \<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,8,36
   READ CYCLE
   ON KEY
   DO FUNCTION
   STORE IL(i) TO M_IL
ENDDO
   CLEAR READ

   OTHERWISE
        M_IL='G2'

   ENDCASE

CLEAR WINDOW WIN2
ACTIVATE SCREEN
CLEAR

DEFINE WINDOW WIN1 FROM 2,2 TO 20,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
DO FUNCTION
@2,1 SAY'ITEM INSPECTED             :' GET M_IN
@4,1 SAY'LOT NUMBER                 :' GET M_LN
@6,1 SAY'LOT/BATCH SIZE             :' GET M_LS
@8,1 SAY'ACCEPTABLE QUALITY LEVEL   :' GET M_AQL
@10,1 SAY'SAMPLING PLAN TYPE         :' GET M_ST
@12,1 SAY'INSPECTION LEVEL           :' GET M_IL
@14,1 SAY'SEVERITY LEVEL             :' GET M_SL
WAIT'PRESS ANY KEY TO CONTINUE'WINDOW
CLEAR WINDOW WIN1
CLEAR
DEFINE WINDOW WIN1 FROM 2,2 TO 15,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
INPUT1='NO '
@4,1 SAY'DO YOU WISH TO CHANGE INPUT DATA ?';
GET INPUT1 PICTURE '@M NO,YES' MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTION'
READ
IF INPUT1='YES'
   INPUT=2
ELSE
   EXIT
ENDIF
ENDDO

CLEAR WINDOW WIN1
ACTIVATE SCREEN
```

```
ELSE

 CLEAR
 M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
 M_1=FILE(M_FN)

DO WHILE M_1=.F.
      ON ERROR DO ERRHAND
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN1 FROM 2,2 TO 21,79;
      TITLE 'INPUT SCREEN' DOUBLE SHADOW
      ACTIVATE WINDOW WIN1
      CLEAR
      ?CHR(7)
      @1,2 SAY'"FILE NOT FOUND !" CHOOSE ANOTHER FILE...'
      @16,2 SAY'IF ERROR OCCURS & DRIVE IS NOT READY PRESS <A> TO ABORT OR ';
      COLOR SCHEME 23
      @17,2 SAY'INSERT DISK IN RIGHT DRIVE AND PRESS <R> TO RETRY......'COLOR S
      RESTORE MACROS
      DEFINE POPUP FILE FROM 1,45 TO 13,60 TITLE'FILE' PROMPT FILES LIKE D:\QC\
      SCROLL SHADOW COLOR SCHEME 15
      ON SELECTION POPUP FILE DEACTIVATE POPUP
      ACTIVATE POPUP FILE

      M_FN=PROMPT()
      M_1=FILE(M_FN)
ENDDO
*****************************************
* CHECK IF LAST LOT INSP-RESULTS WERE INPUT
*****************************************
USE &M_FN
GO BOTTOM
IF T_SAMP_SIZ=0
         DEFINE WINDOW INF FROM 10,15 TO 19,65 DOUBLE SHADOW COLOR SCHEME 7
         ACTIVATE WINDOW INF
         ?CHR(7)
         @0,15 SAY'** WARNING ! **'COLOR SCHEME 20
         @2,3 SAY'** LAST LOT RESULTS HAVE NOT BEEN INPUT **'
         @3,1 SAY'** PLEASE INPUT INSPECTION RESULTS TO PROCEED**'
         DO KEY1
         STORE 1 TO CHOICE1
         @6,17 GET CHOICE1 PICTURE'@*T \!\<CONTINUE' DEFAULT CHOICE1;
         SIZE 1,12,1
         READ
         ON KEY
         DO FUNCTION
         DO RET_MAIN
         RETURN

ENDIF


M_FOUND=.T.
DO WHILE M_FOUND=.T.
   CHOICE=2
   DO WHILE CHOICE!=1
   ACTIVATE SCREEN
```

```
CLEAR
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1
CLEAR
RESTORE MACROS FROM ARROW

@3,2 SAY'ENTER ITEM INSPECTED NAME : ';
GET M_IN PICTURE '@S15'

@6,2 SAY'ENTER LOT NO. : ';
GET M_LN MESSAGE'LOT NUMBER MUST BE LARGER THAN 0';
VALID M_LN>0

@9,2 SAY'ENTER LOT/BATCH SIZE : ';
GET M_LS MESSAGE'LOT SIZE MUST BE LARGER THAN ONE';
VALID M_LS >1

RESTORE MACROS
STORE 1 TO CHOICE
@14,35 GET CHOICE PICTURE'@*T \!\<OK';
SIZE 1,8,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
READ CYCLE
DO LINE24
ENDDO
 DO M_CHECK
ENDDO

          DO SWITCH WITH M_SL,M_AQL,M_TEMP,M_FN,M_FIRST,M_ST,M_IL

ENDIF

IF M_TEMP='DISCONTINUE'
        CLEAR
        DEFINE WINDOW S_LEVEL FROM 8,12 TO 15,62 DOUBLE SHADOW COLOR SCHEME 7
        ACTIVATE WINDOW S_LEVEL
        ?CHR(7)
        @0,18 SAY'** WARNING! **' COLOR SCHEME 20
        @2,1 SAY'** DISCONTINUE INSPECTION..IMPROVE QUALITY ! **'
        DO KEY1
        STORE 1 TO CHOICE1
        @5,18 GET CHOICE1 PICTURE'@*T \!\<CONTINUE' DEFAULT CHOICE1;
        SIZE 1,12,1
        READ CYCLE
        ON KEY
        DO FUNCTION
        DO RET_MAIN
        RETURN
ELSE
        CLEAR

        DO SAMPCODE WITH M_IL,M_SC,M_LS

        DO CASE

                CASE UPPER(M_ST)='SINGLE'
                DO SING WITH M_SC,M_AQL,M_SL,M_FIRST,M_FN,M_ST,M_IL,M_IN,M_LN,M
                CASE UPPER(M_ST)='DOUBLE'
                DO DOUB WITH M_SC,M_AQL,M_SL,M_FN,M_FIRST,M_ST,M_IL,M_IN,M_LN,M
                CASE UPPER(M_ST)='MULTIPLE'
```

```
YPE SELECTION SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN2
                                                                    B22
** SAMPLING PLAN TYPE SINGLE/DOUBLE/MULTIPLE **

STORE 2 TO CHOICE
STORE 1 TO CHOICE1

DO WHILE CHOICE=2

CLEAR

IF UPPER(M_R1)='Y'

   DO KEY
   @4,25 SAY 'ENTER SAMPLING PLAN TYPE'
   @6,30 GET CHOICE1 FUNCTION '*RT \<SINGLE;\<DOUBLE;\<MULTIPLE' DEFAULT 1 SIZE
   MESSAGE'SCROLL FOR DIFFERENT OPTION' COLOR SCHEME 14
   READ CYCLE
   ON KEY
   DO FUNCTION
   DO KEY1
   STORE 1 TO CHOICE
   @15,15 GET CHOICE PICTURE'@*TH \!\<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,10,33  MESSAGE' CONFIRM SELECTION BY SELECTING THE OK BUTTON'
   READ CYCLE
   ON KEY
   DO FUNCTION

DO CASE
      CASE CHOICE1=1
      M_ST='SINGLE'
      CASE CHOICE1=2
      M_ST='DOUBLE'
      CASE CHOICE1=3
      M_ST='MULTIPLE'
ENDCASE

ELSE
    STORE SAMP_TYP TO M_ST
    EXIT
ENDIF
ENDDO

   CLEAR READ

CLEAR WINDOWS
ACTIVATE SCREEN
CLEAR

STORE 2 TO CHOICE
DO WHILE CHOICE=2

CLEAR
@2,2 TO 22,75 COLOR SCHEME 14
@2,18 SAY'ACCEPTABLE QUALITY LEVEL SELECTION SCREEN' FUNCTION'I';
COLOR SCHEME 14
@4,6 SAY' AQL IS MAX. %DEFECTIVE OR MAX. NO.OF DEFECTS PER HUNDRED UNITS';
COLOR SCHEME 18
```

```
IF UPPER(M_R2)='Y'

   STORE 11 TO i
   @6,4 SAY 'ENTER ACCEPTABLE QUALITY LEVEL :'
   @8,15 GET i FROM AQL MESSAGE' ' DEFAULT 11 COLOR SCHEME 15

   DO KEY1
   STORE 1 TO CHOICE
   @13,55 GET CHOICE PICTURE'@*TV  \! \<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,10,2
   READ CYCLE
   ON KEY
   DO FUNCTION
   STORE AQL(i) TO M_AQL

ELSE
   STORE AQL TO M_AQL
   EXIT

ENDIF
ENDDO
    CLEAR READ
    CLEAR WINDOWS
    CLEAR

DEFINE WINDOW WIN2 FROM 2,2 TO 20,79;
TITLE 'INSPECTION LEVEL SELECTION SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN2

STORE 2 TO CHOICE
DO WHILE CHOICE=2
CLEAR

IF UPPER(M_R3)='Y'

   STORE 6 TO i
   @2,2 SAY 'ENTER INSPECTION LEVEL :';
   GET i FROM IL DEFAULT 6 COLOR SCHEME 15
   DO KEY1
   STORE 1 TO CHOICE
   @15,10 GET CHOICE PICTURE'@*TH \! \<OK;\<CANCEL' DEFAULT 1;
   SIZE 1,8,36
   READ CYCLE
   ON KEY
   DO FUNCTION
   STORE IL(i) TO M_IL

ELSE
    STORE INSP_LEVEL TO M_IL
    EXIT

ENDIF
ENDDO
   CLEAR READ
ENDIF
CLEAR WINDOWS
DO CASE
        CASE UPPER(M_SL)='NORMAL'
        DO NTR WITH M_COUNT,M_FN,M_SL,M_AQL
        CASE UPPER(M_SL) ='TIGHTENED'
```

```
RETURN

*************************************************************
*                  SAMPLE SIZE CODE SELECTION               *
*************************************************************

PROCEDURE SAMPCODE
PARAMETER M_IL,M_SC,M_LS

DO CASE
   CASE UPPER(M_IL)='S1'
   USE S1
   CASE UPPER(M_IL)='S2'
   USE S2
   CASE UPPER(M_IL)='S3'
   USE S3
   CASE UPPER(M_IL)='S4'
   USE S4
   CASE UPPER(M_IL)='G1'
   USE G1
   CASE UPPER(M_IL)='G2'
   USE G2
   CASE UPPER(M_IL)='G3'
   USE G3

ENDCASE

GO TOP
SET FILTER TO BETWEEN(M_LS,SLOTSIZE,ELOTSIZE)
GO TOP
STORE M_SC TO M_SC
SET FILTER TO
USE
RETURN

**********************
PROCEDURE KEY
**********************
ON KEY LABEL LEFTARROW
ON KEY LABEL RIGHTARROW
RETURN

**********************
PROCEDURE KEY1
**********************
ON KEY LABEL UPARROW
ON KEY LABEL DNARROW
RETURN

**********************
PROCEDURE RETURN
**********************
RETURN

**********************
PROCEDURE FUNCTION
**********************
ON KEY LABEL F1 DO RETURN
ON KEY LABEL F2 DO RETURN
ON KEY LABEL F3 DO RETURN
```

```
ON KEY LABEL F4 DO RETURN

ON KEY LABEL F5 DO RETURN
ON KEY LABEL F6 DO RETURN
ON KEY LABEL F7 DO RETURN
ON KEY LABEL F8 DO RETURN

ON KEY LABEL F9 DO RETURN
ON KEY LABEL F10 DO RETURN
ON KEY LABEL F11 DO RETURN

ON KEY LABEL F12 DO RETURN
```

```
*****************************************************************
                        PROCEDURE INF
*****************************************************************

HIDE MENU MAIN_POP
HIDE POPUP PROGRAM
CLEAR WINDOW MAIN
RESTORE MACROS
ON KEY
DO FUNCTION

CLOSE ALL

STORE SPACE(20) TO M_FN
STORE 0 TO M_LN
STORE 0 TO M_TOT_DEF
STORE 0 TO M_TOT_SAMP_SIZE
STORE SPACE(3) TO M_RESUB
STORE SPACE(10) TO M_A_R_T
STORE SPACE(1) TO M_RESP
STORE SPACE(10) TO M_ISNAME
STORE SPACE(10) TO M_IN

CLEAR WINDOWS
DEFINE WINDOW WIN1 FROM 2,2 TO 18,79;
TITLE 'INPUT SCREEN' DOUBLE SHADOW
ACTIVATE WINDOW WIN1

@2,2 SAY'ENTER FILENAME FOR ITEM INSPECTED  ';
GET M_FN PICTURE '@A,S8' MESSAGE ' '
READ

M_FN='D:\QC\DBASE\'+TRIM(M_FN)+'.DBF'
M_1=FILE(M_FN)

 DO WHILE M_1=.F.
      ON ERROR DO ERRHAND
      CLEAR WINDOW WIN1
      DEFINE WINDOW WIN1 FROM 2,2 TO 21,79;
      TITLE 'INPUT SCREEN' DOUBLE SHADOW
      ACTIVATE WINDOW WIN1
      CLEAR
      ?CHR(7)
      @1,2 SAY'"FILE NOT FOUND !" CHOOSE ANOTHER FILE...'
      @16,2 SAY'IF ERROR OCCURS & DRIVE IS NOT READY PRESS <A> TO ABORT OR ';
      COLOR SCHEME 23
      @17,2 SAY'INSERT DISK IN RIGHT DRIVE AND PRESS <R> TO RETRY......'COLOR S
      RESTORE MACROS
      DEFINE POPUP FILE FROM 1,45 TO 13,60 TITLE'FILE' PROMPT FILES LIKE D:\QC\
      SCROLL SHADOW COLOR SCHEME 15
      ON SELECTION POPUP FILE DEACTIVATE POPUP
      ACTIVATE POPUP FILE

      M_FN=PROMPT()
      M_1=FILE(M_FN)
ENDDO

USE &M_FN

M_FOUND=.F.
```

```
DO WHILE M_FOUND=.F.
CHOICE=2
DO WHILE CHOICE=2

RESTORE MACROS FROM ARROW
CLEAR WINDOW WIN1
DEFINE WINDOW WIN4 FROM 2,2 TO 20,79 ;
TITLE 'INSPECTION INFORMATION INPUT SCREEN' DOUBLE
ACTIVATE WINDOW WIN4

@1,2 SAY'ITEM INSPECTED : ';
GET M_IN PICTURE '@S10'

@3,2 SAY'LOT NUMBER     : ';
GET M_LN VALID M_LN>0 MESSAGE'LOT NUMBER MUST BE LARGER THAN ZERO'

STORE (00/00/92) TO M_IDATE
@1,42 SAY'INSPECTION DATE (DMY) : ';
GET M_IDATE

@3,42 SAY'INSPECTOR NAME      : ';
GET M_ISNAME


@4,0 TO 4,79 DOUBLE COLOR SCHEME 14

@6,2 SAY'TOTAL SAMPLE SIZE';
GET M_TOT_SAMP_SIZE


@9,2 SAY'WAS THE LOT RESUBMITTED ?';
GET M_RESUB PICTURE'@M YES,NO' MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTION'


@12,2 SAY'WAS THE LOT ACCEPTED OR REJECTED OR INSPECTION WAS TERMINATED?';
GET M_A_R_T  PICTURE '@M ACCEPT,REJECT,TERMINATED';
MESSAGE'PRESS SPACE BAR FOR ALTERNATIVE OPTION'


@15,2 SAY 'TOTAL NO. OF DEFECTIVES FOUND DURING INSPECTION';
GET M_TOT_DEF

RESTORE MACROS
ACTIVATE SCREEN
   DO KEY1
   STORE 1 TO CHOICE
   @21,15 GET CHOICE PICTURE'@*TH \!  \<OK  ;\<CANCEL' DEFAULT 1;
   SIZE 1,10,33 MESSAGE 'CONFIRM SELECTION BY SELECTING OK BUTTON'
   READ CYCLE

ENDDO

SET FILTER TO
SET FILTER TO ITEM_INSP=M_IN
LOCATE ALL FOR LOT_NO=M_LN
M_FOUND=FOUND()

IF M_FOUND=.F.

         DEFINE WINDOW S_LEVEL FROM 8,12 TO 15,60 DOUBLE SHADOW COLOR SCHEME 7
```

```
          ?CHR(7)
          @0,15 SAY'** WARNING ! **'COLOR SCHEME 20
          @2,4 SAY'** SAMPLED ITEM IS NOT FOUND IN FILE **'
          DO KEY1
          STORE 1 TO CHOICE1
          @5,1 GET CHOICE1 PICTURE'@*TH \!\<CONTINUE;\<CANCEL' DEFAULT CHOICE1;
          SIZE 1,12,20 MESSAGE'CHOOSE <CANCEL> IF YOU WANT TO CANCEL INSPECTION
          READ CYCLE
          ON KEY
          DO FUNCTION

IF CHOICE1=1
   CONTINUE
   CLEAR WINDOWS
   SET FILTER TO
ELSE
    M_FOUND=.T.
    USE
    CLEAR WINDOWS
    ACTIVATE SCREEN
    CLEAR
    SHOW POPUP PROGRAM
    SHOW MENU MAIN_POP
    CLOSE ALL
    RETURN
ENDIF
ENDIF
ENDDO

*********************************************************************
*       OUTPUT                                                      *
*********************************************************************

CLEAR WINDOWS
ACTIVATE SCREEN
CLEAR

RESTORE MACROS FROM UPDN
DEFINE POPUP OUTPUT RELATIVE SHADOW COLOR SCHEME 4 FROM 6,28 MESSAGE"MAKE A SEI
DEFINE BAR 1 OF OUTPUT PROMPT" \<SAVE RESULTS "
DEFINE BAR 2 OF OUTPUT PROMPT"----------------------"SKIP
DEFINE BAR 3 OF OUTPUT PROMPT" SA\<VE & PRINT RESULTS"
DEFINE BAR 4 OF OUTPUT PROMPT"----------------------"SKIP
DEFINE BAR 5 OF OUTPUT PROMPT" \<MAIN MENU "

ON SELECTION BAR 1 OF OUTPUT DO SAVE WITH BAR()
ON SELECTION BAR 3 OF OUTPUT DO SAV_PRINT WITH BAR()
ON SELECTION BAR 5 OF OUTPUT  DO QUIT
ACTIVATE POPUP OUTPUT
DO RET_MAIN

*********************************************************************
PROCEDURE SAVE
*********************************************************************
PARAMETER M_BAR
ON KEY
DO FUNCTION
CLEAR READ
CLEAR WINDOWS
```

```
CLEAR
USE
USE &M_FN

SET FILTER TO
GO TOP
SET FILTER TO ITEM_INSP=M_IN.AND.LOT_NO=M_LN
GO TOP

REPLACE RESUBMIT WITH M_RESUB
REPLACE A_R_T WITH M_A_R_T
REPLACE TOT_DEFECT WITH M_TOT_DEF
REPLACE T_SAMP_SIZ WITH M_TOT_SAMP_SIZE
REPLACE INSPECTOR WITH M_ISNAME
REPLACE INSP_DATE WITH M_IDATE
REPLACE ITEM_INSP WITH M_IN
SET FILTER TO
   USE
IF M_BAR=3
   RETURN
ELSE
   CLEAR
   SHOW POPUP OUTPUT
   RETURN

*********************************************************************
PROCEDURE SAV_PRINT
*********************************************************************
PARAMETER M_BAR
DO SAVE WITH M_BAR
USE
HIDE POPUP OUTPUT
CLOSE ALL
STORE M_LN TO B_LN
STORE M_LN TO E_LN

USE &M_FN
GO TOP
SET FILTER TO
SET FILTER TO ITEM_INSP=M_IN

IF PRINTSTATUS()
   SET CONSOLE OFF
   SET DEVICE TO PRINTER
   REPORT FORM REPORT TO PRINTER NOEJECT FOR BETWEEN(LOT_NO,B_LN,E_LN)
   SET DEVICE TO SCREEN
   SET CONSOLE ON
ELSE
    WAIT'PRINTER NOT READY.... 'TIMEOUT 2
    DEFINE WINDOW REPORTS FROM 1,0 TO 24,79 TITLE'TO VIEW USE [PGUP] [PGDN]——
    ACTIVATE WINDOW REPORTS
    REPORT FORM D_REPORT TO FILE REPORT.TXT FOR BETWEEN(LOT_NO,B_LN,E_LN)
    USE REP
    APPEND MEMO REPORT FROM REPORT.TXT OVERWRITE
    MODIFY MEMO REPORT NOEDIT WINDOW REPORTS
    DEACTIVATE WINDOW REPORTS
ENDIF

SET FILTER TO
USE
```

```
CLEAR WINDOWS
ACTIVATE SCREEN
CLEAR
SHOW POPUP OUTPUT
RETURN
*************************************************************
PROCEDURE QUIT
*************************************************************
DEACTIVATE POPUP OUTPUT
RELEASE POPUP OUTPUT
RETURN



*************************************************************
PROCEDURE RET_MAIN
*************************************************************

USE
CLEAR
SHOW POPUP PROGRAM
SHOW MENU MAIN_POP
CLOSE ALL
RETURN

*************************************************************
PROCEDURE ERRHAND
*************************************************************
PARAMETER M1,M2
ON ERROR
CLEAR WINDOW WIN1
ACTIVATE SCREEN
CLEAR
RETURN

**********************
PROCEDURE KEY
**********************
ON KEY LABEL LEFTARROW
ON KEY LABEL RIGHTARROW
RETURN

**********************
PROCEDURE KEY1
**********************
ON KEY LABEL UPARROW
ON KEY LABEL DNARROW
RETURN

**********************
PROCEDURE FUNCTION
**********************
ON KEY LABEL F1 DO RETURN
ON KEY LABEL F2 DO RETURN
ON KEY LABEL F3 DO RETURN
ON KEY LABEL F4 DO RETURN

ON KEY LABEL F5 DO RETURN
ON KEY LABEL F6 DO RETURN
ON KEY LABEL F7 DO RETURN
```

```
ON KEY LABEL F8 DO RETURN

ON KEY LABEL F9 DO RETURN
ON KEY LABEL F10 DO RETURN
ON KEY LABEL F11 DO RETURN

ON KEY LABEL F12 DO RETURN

**********************
PROCEDURE RETURN
**********************
RETURN
```

APPENDIX C

INSTALLATION

QUALITY CONTROL EXPERT SYSTEM

FOR

INSPECTION BY ATTRIBUTES

ISO 2859

USERS MANUAL

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INSTALLATION

HARDWARE REQUIREMENTS

"QUALITY CONTROL EXPERT SYSTEM FOR INSPECTION BY ATTRIBUTES ISO 2859" Software will run on any IBM PC compatible computer with a Harddisk, monochrome or color display monitor and any graphics adaptor.

For optimum performance, the recommended hardware should have at least the following specifications :

- 80386 Processor machine
- 4 MB of RAM
- Harddisk
- EGA Graphics Adaptor
- Color Monitor

The more powerful machine will be required for good performance particularly where Databases become large.

SOFTWARE REQUIREMENT

FoxPro version 2.0

SOFTWARE INSTALLATION

To install the " Quality Control Expert System For inspection by Attributes ISO 2859 " proceed with the following steps :

1. Be sure that Foxpro route exits in the autoexec.bat file
2 . Be sure that you have at least 1 MB free disk on your harddisk, drive C:
3 . Be sure that you do not have a subdirectory named "QC"
4 . At the C:\prompt : md QC
5 . At the C:\prompt : cd QC
6 . Insert Diskette 1 in the Floppy Driver
7 . At the C:\prompt : copy a:*.* or b:*.*
8 . Insert Diskette 2 in the Floppy Driver
9 . At the C:\prompt : copy a:*.* or b:*.*
10. At the C:\prompt : md dbase (this subdirectory will contain the created databases by the system)

The system is now ready to run.

To start the system at the root directory at the c:\prompt type:

C:> *Foxprol main*

SYSTEM DESCRIPTION

SYSTEM DESCRIPTION

The Quality Control Expert System is designed to determine sampling plans using the International Standard ISO 2859 (MIL-STD-105D) for inspection by attributes.

The sampling plan indicates the number of units of product from each lot/batch to be tested (sample size) and the criteria for determining the acceptability of the lot (acceptance & rejection numbers).

The system creates a database for each new item to be inspected which includes the sampling plan and the results of the inspection. These databases will be stored in subdirectory dbase. This knowledge will be examined to determine future sampling plans.

The software is menu driven and the user need not be a programmer to be able to use it. The software is fully proofed and error messages are self-explanatory.

MAIN SCREENS

FIRST MAIN SCREEN

Main Menu

The main menu contains the following options :

HELP	FILE	PROGRAM	EDIT	REPORT	EXIT

Mode Selection :

- Help : Gives details on sampling plans and sampling criteria.
- File : Delete or save database
- Program : Select sampling plan & Input inspection results.
- Edit : Delete a record from a specific database.
- Report : View data of all or specific records in a database.
- Exit : Exit the system and returns to DOS.

The user can select the mode by pressing the Enter key on the option or pressing the highlighted letter of the option.

Once the user presses a key, the user will be placed in the appropriate screen in the desired mode.

2. File Mode

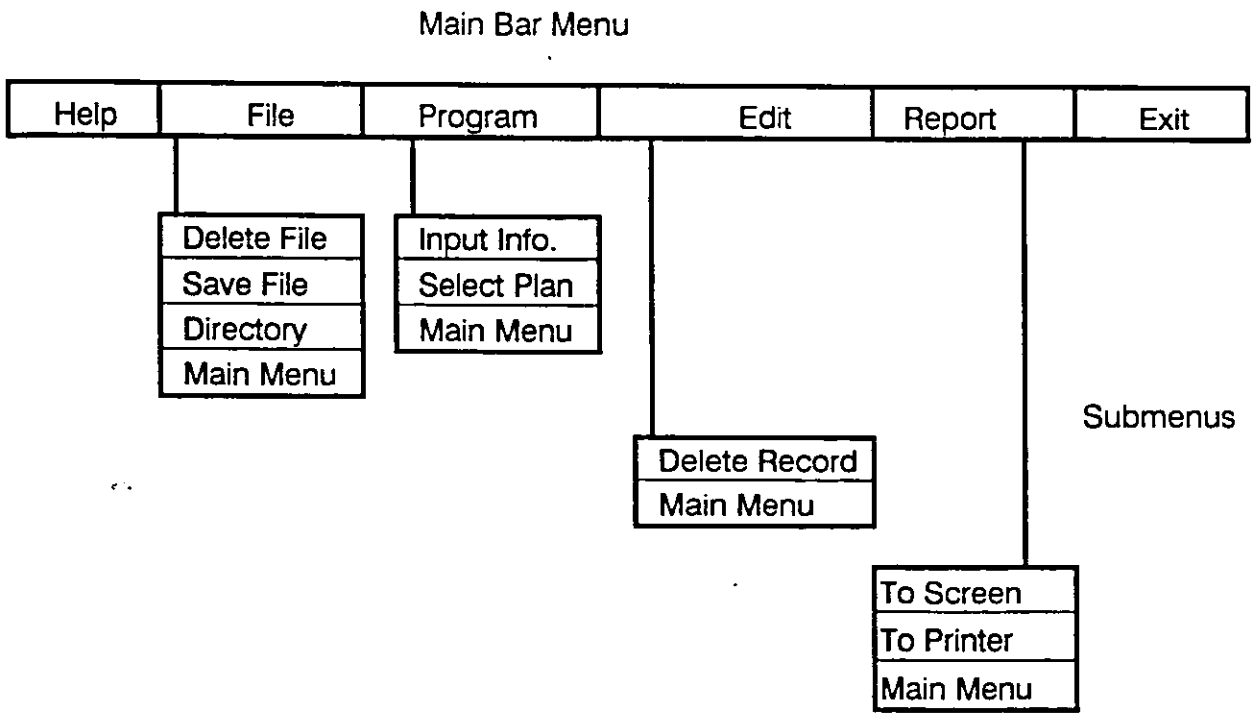
Upon selecting this mode, the user must decide whether to :

1. Delete database file
2. Save database file on disk
3. Return to main menu

In the event of choosing option 1 or 2, a message will be displayed at the end and the user will be prompted to choose whether to confirm or cancel selection. If any error occurs, error messages will be displayed to tell the user what to do.

Once the user is out of this interface, he will be back to the file mode for a new selection.

Figure [1.0] illustrates the contents and format of the main menu and the submenus.

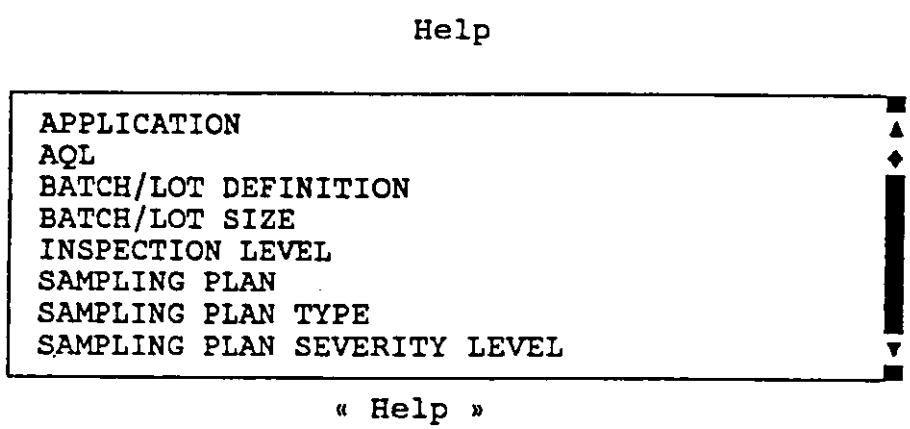


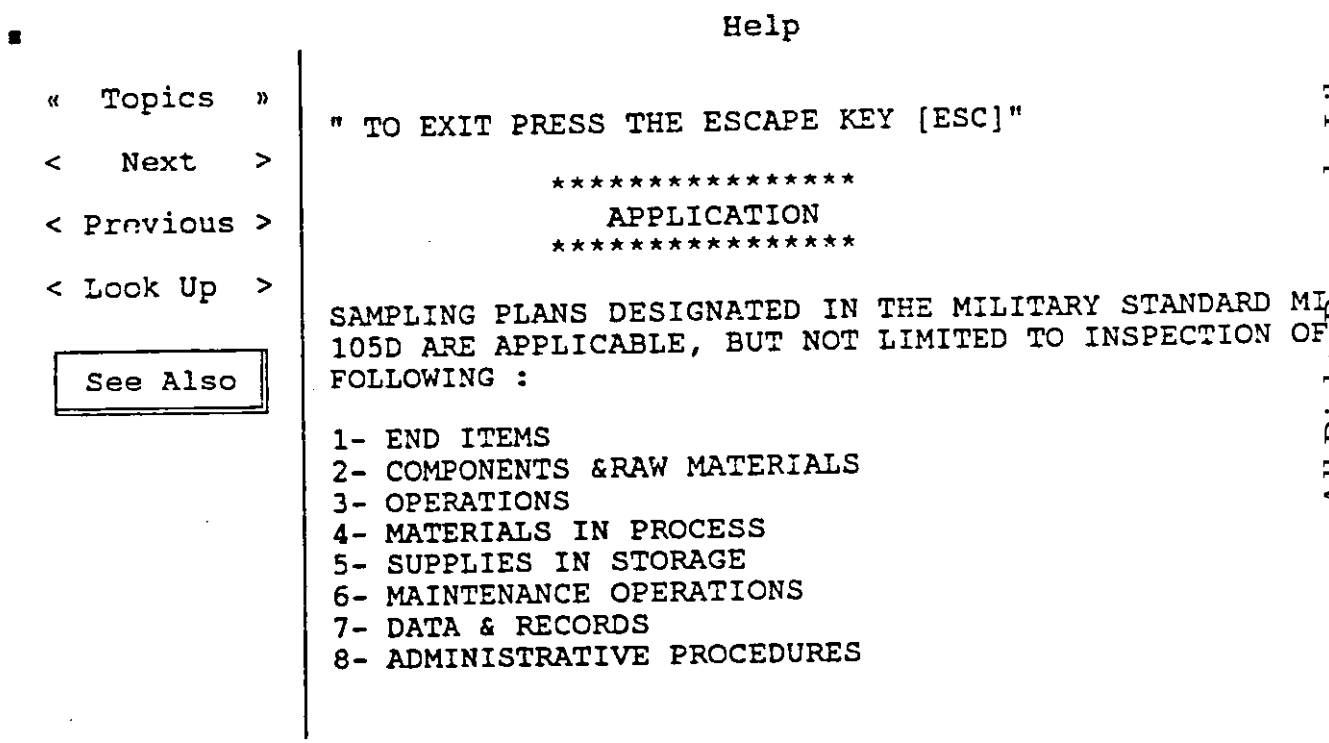
1. Help Mode

The help mode gives the user the opportunity to inquire about the various aspects of the sampling plan.

The following diagrams demonstrate the output of Help mode.

You can select an option by pressing the Enter key on the option. Here we choose the Application option.





3. Program Mode

Upon selecting this mode, the user must decide whether to :

1. Input inspection results
2. Select a sampling plan
3. Returns to main menu

In the event of choosing options 1 or 2, secondary screens will be displayed. The screens have help messages at the bottom to guide the user while running the system. Also the error messages are self-explanatory.

Once the user is out of this interface, he is back to the Program mode for a new selection.

Note : If it is not an initial inspection, to select a new sampling , the inspection results of the previous lot must be input before you proceed with the sampling. Otherwise an error message will be displayed and the selection of a sampling plan will be canceled.

4. Edit Mode

In this mode you can :

1. Delete a record from a database
2. Return to main menu

When deleting a record, a final message will be displayed and the user will be prompted to choose whether to confirm or cancel the deletion of the record.

Note : If the database becomes empty, the database will be deleted.

5. Report Mode

Upon selecting this mode, the user must decide whether to :

1. Send output to the screen
2. Send output to the printer
3. Returns to main menu

IMPORTANT WARNING

In the event that the user strikes a key to proceed with printing before the printer is ready, an error message will be displayed and the user is returned to the Report Mode.

The user **MUST** prepare the printer and select To Printer again.

IMPORTANT WARNING

DO NOT TURN OFF THE COMPUTER

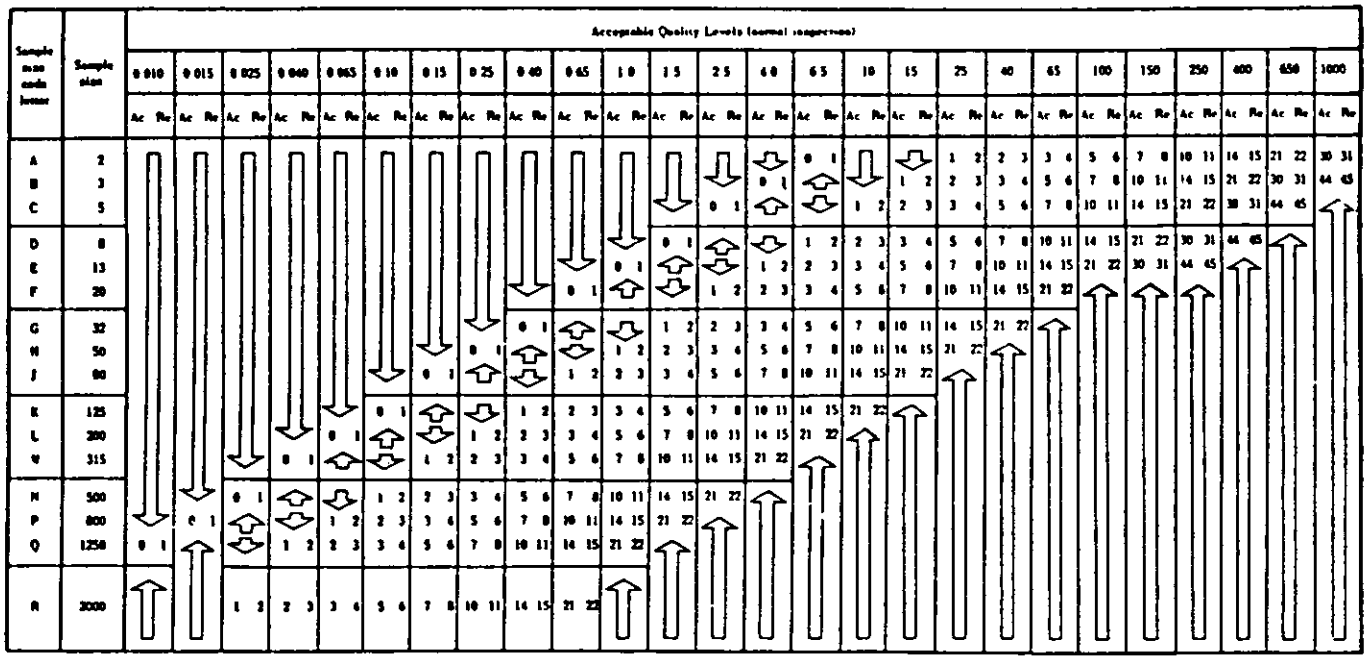
The user **MUST** choose the **EXIT** option from the main menu to leave the system.

APPENDIX D

TABLE I—Sample size code letters

Lot or batch size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1200	C	C	E	F	G	J	K
1201 to 3200	C	D	E	G	H	K	L
3201 to 10000	C	D	F	G	J	L	M
10001 to 35000	C	D	F	H	K	M	N
35001 to 150000	D	E	G	J	L	N	P
150001 to 500000	D	E	G	J	M	P	Q
500001 and over	D	E	H	K	N	Q	R

TABLE II-A—Single sampling plans for normal inspection (Master table)



⇩ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.

⇧ = Use first sampling plan above arrow.

Ac = Acceptance number.

Re = Rejection number.

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