Software Analysis of the Efficiency of Submersible Pump Motor

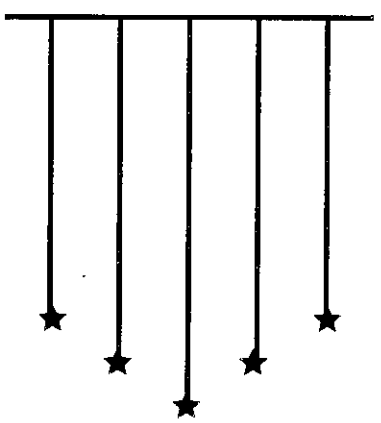
P-519

PROJECT REPORT

Submitted by

ARUL KUMAR. S

BABU. M



2000 - 2001

Guided by

Ms. C. SASIREKHA, B.E.
LECTURER

in partial fulfillment of their requirement
for the award of the degree of
Bachelor Of Engineering in
Electrical And Electronics Engineering
Branch of the Bharathiar University

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CERTIFICATE

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COIMBATORE – 641006
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

This is to certify that the project entitled

Software Analysis of the Efficiency of Submersible Pump Motor

has been submitted by

Mr. S. Arul Kumar
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In partial fulfillment of the requirements for the award of Degree Of Bachelor Of Engineering in Electrical And Electronics Engineering branch of the Bharathiyar University, Coimbatore - 641006, during the academic year 2000-2001.

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This is to certify that **Mr. S. ARUL KUMAR**, Final year BE (Electrical and Electronics Engineering) students of.
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Period of project work: Dec 2000 to Feb 2001.

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Lastly we express our gratitude to our parents and friends for their moral support and patronage.

SYNOPSIS

SYNOPSIS

"Efficiency analysis of submersible pump motor implementing software" deals with the calculation of efficiency of submersible pump motor under testing.

After the calculation of efficiency the range chart is drawn which depicts the varied efficiency of different motors during testing. The software implemented for the project is Visual Basic 6.0 (Front end) with MS-Access 97 (Back end).

The project shows all the forms, which includes winding report, voltage, current and watt reading. With the formula being incorporated the efficiency is calculated and the range chart is drawn. The calculated efficiency should lie within the range as specified by Indian standards. If the efficiency lies outside the range then the factors responsible for the varied efficiency is displayed.

DEDICATED TO
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PARENTS

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CONTENTS

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CHAPTER 1
INTRODUCTION

CHAPTER 1

INTRODUCTION

In India, over 70% of the land is utilized for agriculture. Water is the main resource for agriculture mainly water from river, rain do not fulfill the necessary requirements and so we go in for water below the ground level. To utilize this we need pumps, motors to run the pumps. The various pumps used are Centrifugal pumps, Mono-block pumps and submersible pumps. Since the Submersible pump motor has got a better efficiency than the other pump motors we analyze the efficiency of submersible pump motor. Here we take a set of sample motor readings to calculate the efficiency and the characteristic curve is drawn. Here the analysis of efficiency of the submersible pump motor is being carried out using software.

1.2 Organization profile:

"BEST ENGINEERING PUMPS LIMITED" located at 59-B, Thadagam road, Coimbatore is one of the leading pump manufacturer among the pump industries. The objective in best group is to satisfy the needs of the dear and valid customers.

The product range in BEST ENGINEERS includes domestic Mono Blocs, Centrifugal Jet Pumps, Agricultural Pumps, Submersible Pumps, all versatile products, which function under a wide range of voltage fluctuations from –30 % to + 10 % to suite Indian conditions.

The specialized R & D cell of "BEST ENGINEERS" with ISO 9002 certification for inspection of components and testing of pumps, motors and all their accessories, control the quality of all components of the products and test the performance of the product and release the product only after final inspection and approval.

The quality control covers all our activities right from conception, design, manufacture, dispatch and after sales service. The products are marked with ISI ratings.

Best pumps marketing service ltd., sales and service outlets, staffed with trained personnel are located through out the country and cater to the needs of customers efficiently and effectively. Genuine, inexpensive spare parts are easily available. R & D work is on for developing solar cells and pumps, wind energy controlled pumps and multistage self - priming pumps.

CHAPTER 2
SYSTEM ANALYSIS

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM LIMITATIONS

- The existing system used in the company is FoxPro database.
- FoxPro language has many limitations. It would not provide a good user-friendly interface.
- Different forms can't be connected as in Visual Basic. Also it lacks flexibility.
- Security for accessing database is not provided.

2.2 PROPOSED SYSTEM

The proposed system will be a completely automated "Graphical User Interface" (GUI). It overcomes all the drawbacks of the existing system.

2.3 FEATURES OF PROPOSED SYSTEM

- Uses a database to store all the relevant information.
- No data is lost unless it is decided to erase some unwanted (or) too old data.
- The database serves as long as for the various input activities.
- Shortcuts are available apart from the menu driven events.
- Automatic transfer of records to the necessary database occurs once the formalities are undergone.
- Uses GUI for data entry.

CHAPTER 3
SUBMERSIBLE PUMP MOTORS

CHAPTER 3

SUBMERSIBLE PUMP MOTORS

3.1 INTRODUCTION

The submersible pump motor basically used is the poly phase induction motor. This is the most widely used ac motor due to its low cost and extremely rugged construction, high-efficiency, reasonably good power factor, low maintenance cost and simple starting arrangement. It differs from other types of motors where there are no electrical connections from the rotor winding to any source of supply. The necessary voltage and current in the rotor circuit are produced by induction from the stator winding and hence termed as induction motor.

3.2 DETAILS

3.2.1 CONSTRUCTION:

The submersible pump motor consists of two main parts.

1) Stationary part known as stator.

2) Revolving part known as rotor.

3.2.1.1 STATOR:

The armature is an iron ring formed of laminations of special magnetic iron or steel alloy (silicon steel) having slots on its inner periphery to accommodate armature conductors and is known as stator. The whole structure is held in a frame, which may be of cast iron or welded steel plate. Since the field rotates in between the stator so that flux of the rotating field cuts the core of the stator continuously and causes eddy current losses in the stator core. In order to reduce eddy currents in the stator core it is assembled of high grade, low electrical losses, and silicon steel punching. The punching are insulated from one another by a coating of varnish and held together by bolts in insulating sleeves.

In order to keep air gap reluctance minimum the air gap between the stator and rotor is made as small as practicable. The core and windings are enclosed in cast iron frame. In submersible pump motor the stator winding is usually arranged for three phase power supply, the phase of which may be connected either in star or delta depending upon the connection which will give better design for the particular machine. It is wound for definite no of poles as per the requirement of speed. Greater

the number of poles, lesser the speed and vice versa for a supply of given frequency.

3.2.1.2 WINDING DETAILS:

The Winding Wires having an outstanding Electrical, Mechanical, Thermal & Chemical properties. These are quite sturdy, robust and miniaturized too. These are not only fulfilling the requirement of all available standards but even better in many aspects. These winding wires can withstand water abrasion and frictional losses, saves space/size, cost and work in every type of typical conditions. In brief the details are as follows:

HIGH TEAR RESISTANT:

The structure of insulation is oriented bi-axially. Propagation of tears is difficult. Uni-axial orientation makes it easy to tear the insulation along the axis of the wire.

HIGH DIELECTRIC STRENGTH:

The multiple layer construction of Polywin insures high dielectric quality of insulation. Any flaw is limited to a single layer of the tape. The wrapping process places the insulation concentrically around the conductor.

HIGHER CUT THROUGH & ABRASION RESISTANT:

Polywin insulation is remarkable resistant to cut through and scrap abrasion. Thin cross sections of Polywin 0.15mm to 0.25mm thick will endure greater cut through stress and general abuse than 0.25mm to 1.0mm of insulation such as PVC, Nylon Jacketed PVC.

HIGH INSULATION RESISTANCE:

It has remarkable constant & thousands time higher insulation resistance even at boiling point of water than PVC.

HIGH TENSILE STRENGTH:

Polywin insulation adds significantly to the tensile strength of the insulated conductor through the mechanics of load transfer because the insulation has such a superior breaking strength. It will support the wire at each point where excessive stretching occurs. Wire insulates with conventional materials will break since there is no support from insulation.

HIGHER FLEX LIFE:

The insulation is produced by bi-axially oriented synthetic films. It has very high flex life in comparison to any other insulating materials.

WORKING TEMPERATURE:

For short periods: +130^0 C

Continuous: -60^0 C to +120^0 C

Sizes: 0.4mm to 6.0mm (Single-solid), 4.0Sq.mm to 50Sq.mm (Multistrand).

Insulation thickness: 0.10mm to 0.50mm (as per customer's requirements)

Indian standard: IS: 8783 - 1995.

POLYFLON – PTFE (Poly Tetra Fluro Ethylene) insulated Winding wire for 250^0 C and for any chemical or oil filled pumps.

The different wire size available for different Horse Power and current rating of submersible pump motor is given in **Table-2 of Appendix**

3.2.2 ROTOR:

The rotor employed in submersible pump motor may be any one of the two types namely.

1) Squirrel cage

2) Wound rotor or slip ring almost 90% of submersible pump motor are provided with squirrel cage rotor because of its very simple robust and almost instruct able construction.

SQUIRREL CAGE ROTOR:

The rotor of a squirrel cage motor is constructed of laminated core with the conductors (Copper or Aluminium bars) placed parallel, or approximately parallel to the shaft and embedded in the surface of the core. The conductors are not insulated from the core, since the rotor currents naturally follow the path of least resistance, that is the rotor conductors .At each end of the rotor the rotor conductors are all short circuited by continuous end rings of similar material to that of the conductors. The rotor conductors and their end rings form a complete closed circuit in itself, resembling a squirrel cage, thus explaining the name. The slots on the rotor are always not parallel to the motor shaft

but are usually skewed in order to obtain a more uniform torque and reduce the magnetic humming noise while running.

The slots on the rotor are either of semi-closed type or of totally closed type, because there is little difficulty in inserting the rotor bars in slots of these types. The advantage of semi-closed and totally closed slots is that the effective cross-sectional area of the air gap is increased, therefore magnetizing current is reduced. Such slots also reduce the pulsations of flux in the individual tooth, therefore teeth loss is reduced. The disadvantage of such slots is that these give much higher slot inductance than the open slots which lowers the power factor and reduce the breakdown torque of the motor.

3.2.3 PRINCIPLE OF OPERATION:

When the stator or the primary winding of submersible pump motor is connected to three phase ac supply a rotating magnetic field is established which rotates at synchronous speed .the direction of revolution of this field will depend upon the phase sequence of the primary currents and therefore will depend upon the order of connection of the primary terminals to the supply. The direction of rotation of the field can be reversed by interchanging the connection to the supply of any two leads of a submersible pump motor. The no of magnetic poles of

the revolving field will be the same as the no of poles for which each phase of the primary or stator winding is wound. The speed at which the speed produced by the primary currents will revolve is called the synchronous speed of the motor and is given by the expression.

Syn speed= (120*f)/p

Where,

F is supply frequency

P is no of poles on stator

The revolving magnetic field produced by the primary currents sweeps across the rotor conductors and there by induces an emf in these conductors. Since the rotor windings is either directly shorted or closed through some external resistance, the emf induced in the secondary by the revolving field causes a current to flow in the rotor conductors.

The setting up of the torque for causing the rotor to rotate is explained below:

A section of motor stator and rotor with the magnetic field assumed to be rotating in a clockwise direction and with the rotor

stationary as at starting. The relative motion of the rotor with respect to the stator field is anticlockwise. By applying right hand rule the direction of induced emf or current or current in the rotor conductor is found outward. Hence the direction of the flux due to the rotor current alone is anticlockwise. Now by applying the *left hand rule*, or by the effect of combined field it is clear that the rotor conductor shown experiences a force tending to move the conductor to the right. However other adjacent rotor conductors in the stator field likewise carry current in the same direction as the conductor shown and also have a force exerted upon them tending to move them towards the right. One half cycle later the stator field direction will have reversed, but the rotor currents will have also reversed, so that the force on the rotor is still the same. Likewise the rotor conductors under other stator field poles will have a force exerted upon them all tending top turn the rotor in the clockwise direction. If the developed torque is great enough to overcome the resisting torque of the load, the rotor will accelerate in the clockwise direction or in the same direction as the rotation of the stator field. Motor running at no load will have speed close to synchronous speed and therefore emf in the rotor winding will be very small. This small emf gives a small current producing a torque just sufficient to overcome the losses such as due to friction and maintain the rotor in motion. As the mechanical load is applied on the motor shaft it must slow down because the torque developed at no load will not be sufficient to keep the rotor revolving at

no load speed against the additional opposing torque of load. As the motor slows down, the relative motion between the magnetic field and the rotor is increased. This results in greater rotor current and greater developed torque. Thus, as the load is increased, the motor slows down until the relative motion between the rotor and rotating magnetic field is just sufficient to result in the development of the torque necessary for that particular load.

3.2.4 Classification of tests:

There are two types of tests

1. Type test
2. Routine test

3.2.4.1 TYPE TEST:

The following shall constitute the type tests.

- Insulation resistance test (both before and after the high voltage test).
- High voltage test.
- Measurement of stator resistance.
- No load running of motor and reading of voltage, current, power input and speed.
- Reduced voltage running up test at no load to check the ability of the motor to run up to full speed on no

load in each direction of rotation with 1/1.732 of the rated voltage applied to the motor (for three phase motors only).

- Locked rotor readings of voltage, current and torque of motor.

  NOTE : This test may be made at a reduced voltage, when a current at least equivalent to full load current is being taken by the motors.

- Full load reading of voltage, current, power input and slip.

  NOTE : Pump may be used as a loading device.

- Performance characteristics .
- Temperature rise test.
- Temperature rise test at a reduced voltage.
- Momentary overload test.
- Vibration test.
- Leakage current test at rated voltage.

3.2.4.2 ROUTINE TEST:

The following shall constitute the routine test.

- Insulation resistance test (before high voltage test only)
- High voltage test.

- ❖ No load running of motor and reading of current and voltage.
- ❖ Locked rotor reading of voltage, current and power input.
- ❖ Reduced voltage running up test at no load to check the ability of the motor to run up to full speed on no load in each direction of rotation with 1/1.732 of the rated voltage applied to motor (for three phase motor only).

TYPES OF SUBMERSIBLE PUMP MOTOR

Wet type submersible pump motor:

It is a motor, which is completely filled with clear water or oil or emulsion of water and oil. The rotor of this motor shall be provided with suitable Epoxy paint to protect it from corrosion under water. The thrust bearing shall be provided with drain plug to empty the oil pure water filled into the thrust bearing housing in motor. The motor is provided with a breathing attachment like bellows, diaphragm, etc. to compensate the volumetric variation of water inside the motor due to changes in the temperature. Here in BEST ENGINEERS they manufacturers these types

of pump motors. This motor is shown in **fig.** 3.1 The total pump installation is shown in **fig.** 3.4

Resin filled submersible pump motor:

It is a motor, where stator is encapsulated and filled with an insulating compound. The remaining portion is filled with water or oil. This motor is shown in **fig.** 3.2

Sealed submersible pump motor:

It is a motor, where winding as well as entire remaining space within the motor is filled with air or suitable grade of oil. This motor is shown in **fig.** 3.3

The values of performance characteristics of two pole three phase submersible pump motor is given in **Table 1 of Appendix**

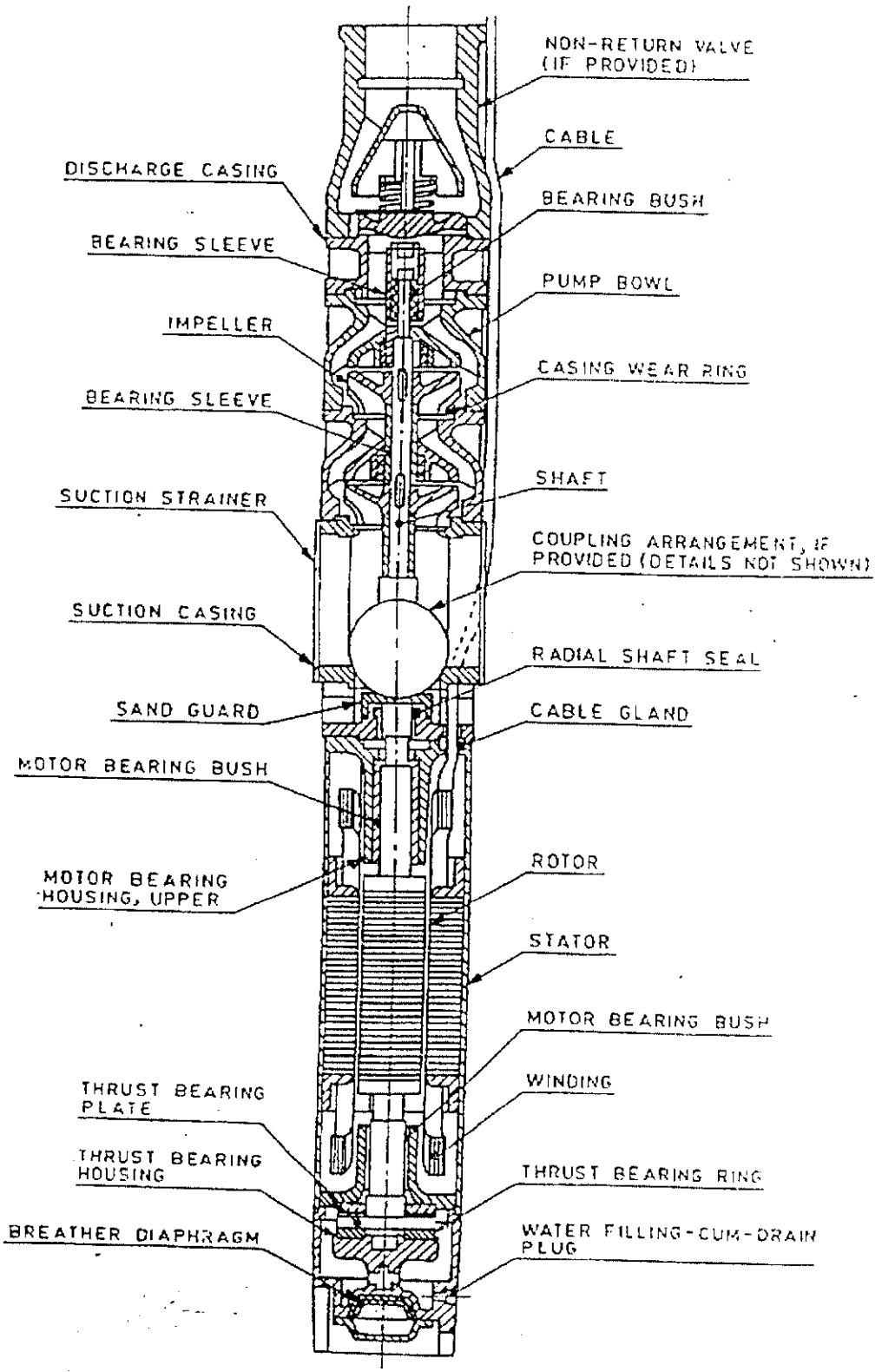


Fig.3.1 WET TYPE WATER FILLED MOTOR

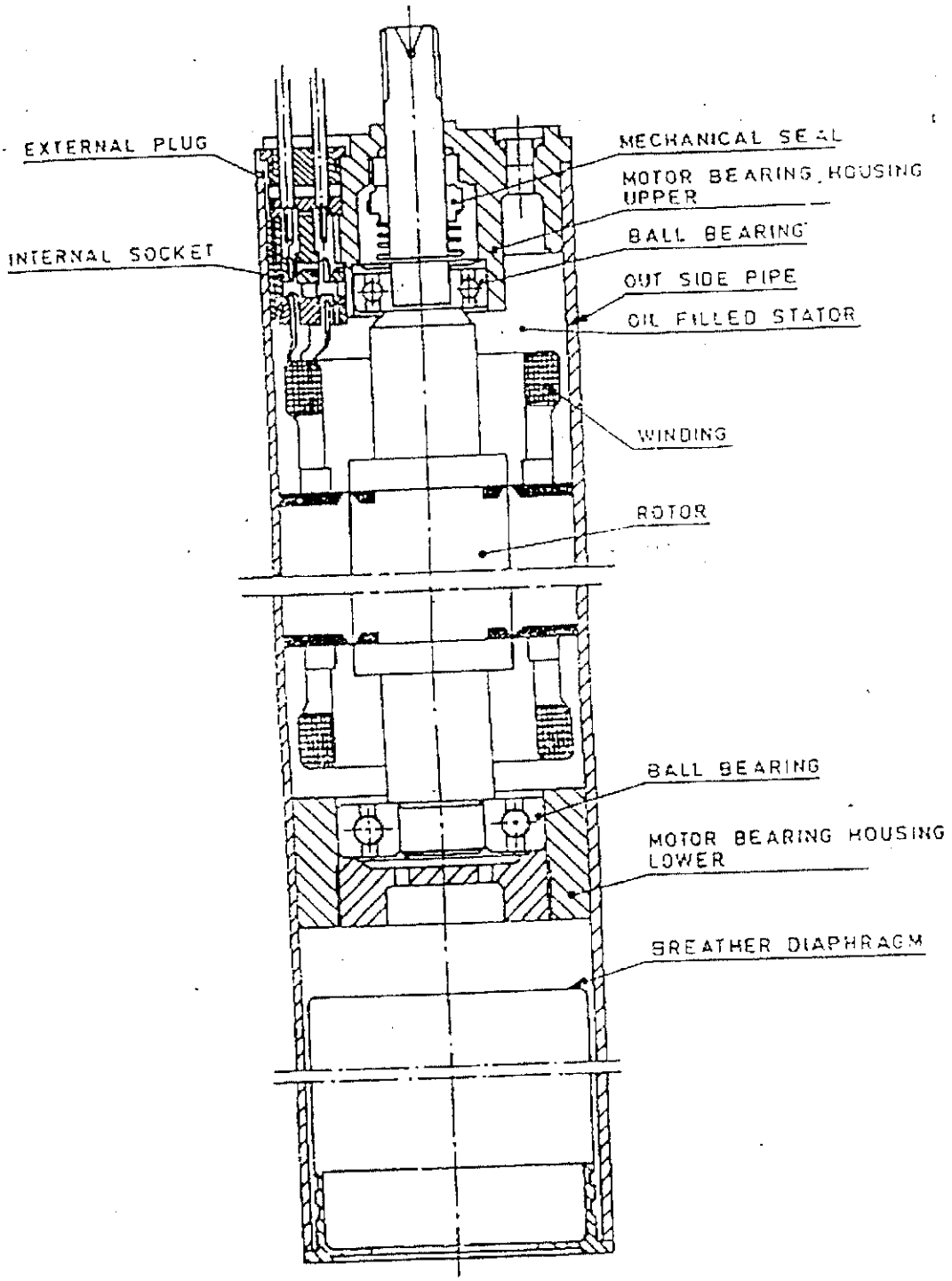


FIG. 3.2. WET TYPE OIL FILLED MOTOR

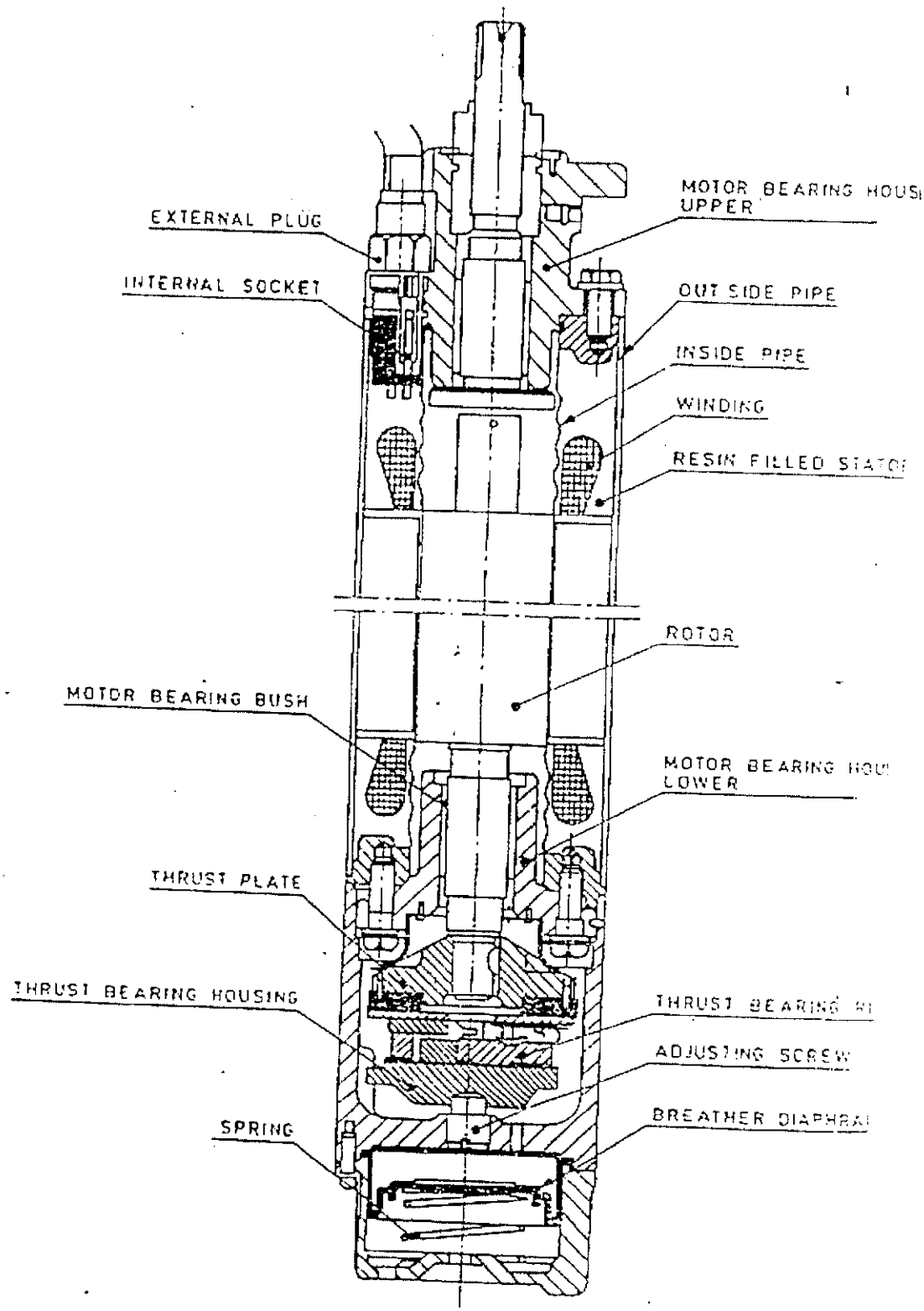


FIG. 3.3. RESIN FILLED MOTOR

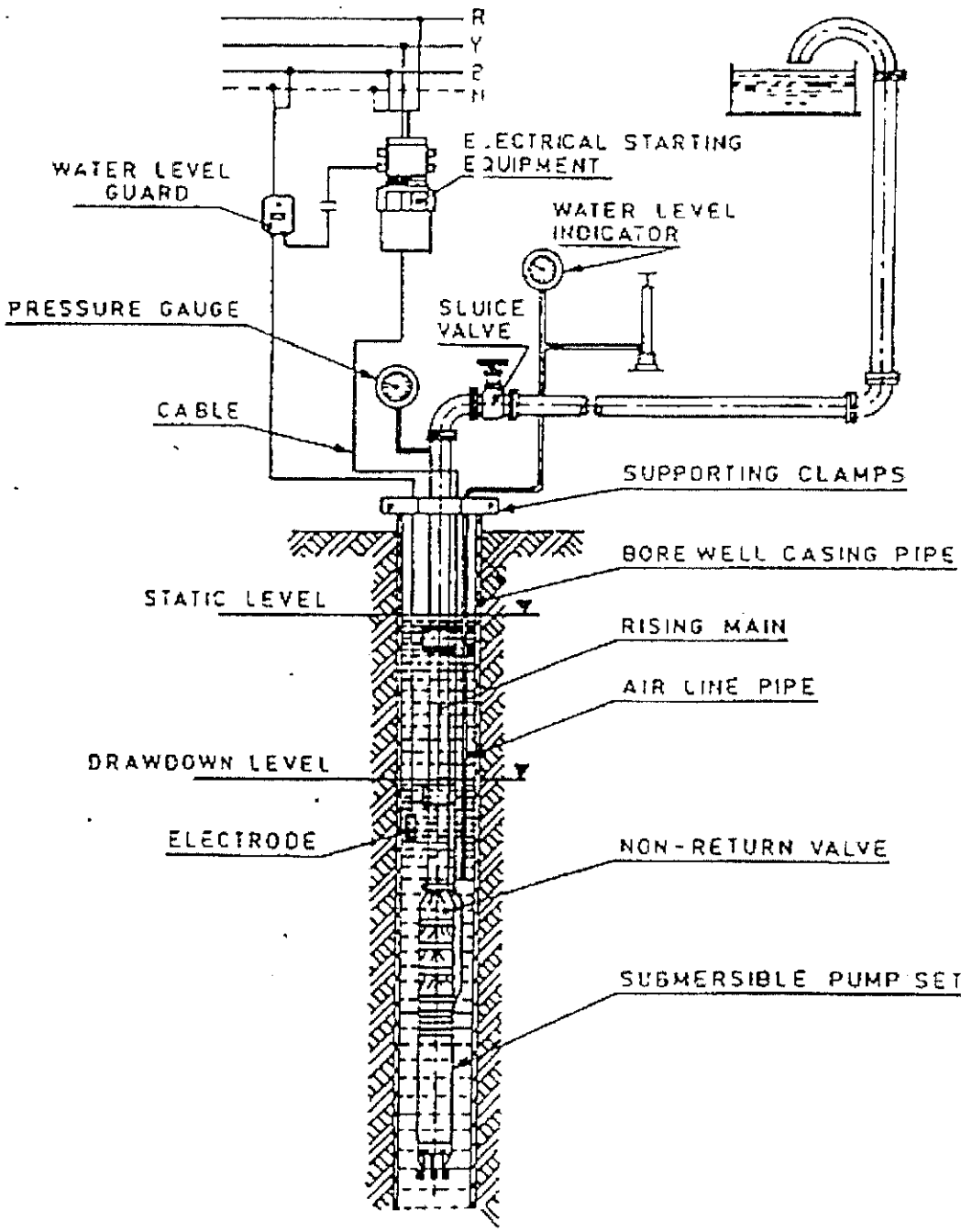


FIG. 3.4. SUBMERSIBLE PUMP SET INSTALLATION

3.3 Applications of submersible pump motor:

- Mainly used for water well pumping system.
- Used for underground gasoline storage pumping system.
- Supplies factory with industrial water.
- Used in fountain, decorative waterfall.
- Supply or drain water at engineering construction work.
- Draining of waste water, sewage disposal plant.
- Transfer solid at sewage, excreta disposal plant.
- Used in stock forming.

CHAPTER 4
PROGRAMMING ENVIRONMENT

CHAPTER 4

PROGRAMMING ENVIRONMENT

4.1 HARDWARE CONFIGURATION

Machine type	-	HCL Busybee, Compaq
Processor configuration	-	Pentium II
Operating frequency	-	266 MHZ
Hard disk capacity	-	2.1 GB
Cache memory	-	512 KB
RAM Capacity	-	32 MB
Monitor type	-	SVGA color
Floppy disk	-	1.44 MB
Keyboard type	-	104 keys PC XT/AT

4.2 SOFTWARE ENVIRONMENT

OPERATING SYSTEM	:	MS WINDOWS 98
FRONT END TOOL	:	MS VISUAL BASIC6.0 (Enterprise Edition)
BACK END TOOL	:	MS ACCESS 7.0
DATA ACCESS METHOD	:	DAO (data access objects).

description of the software packages: used-reasons

4.2.1 windows 98 :

Though MS-Dos offered good functionality, the text interface was less interactive and difficult for a common user to get used to. It was not for a layman to grasp and remember the Dos commands. Windows offered a visual or a Graphical User Interface (GUI)which is very easy to use.

Every Dos program had a different user interface, which the user needs lots of time to get adjusted. Windows eliminated such problems by offering a consistent user interface. So the user took no time to learn to interact to these programs.

From the prospective of the user the shift from MS-Dos to windows operating systems involved switching over to graphical user interface from the old Command Line Interface (CLI). Another change the user may fell and appreciate is the ability to windows operating systems to execute several programs simultaneously.

Windows programs are event driven programs and must deal with the keyboard and must deal with the keyboard and mouse inputs that can be directed at numerous user interface objects such as menus and Ms-Dos .the windows programs are driven by events that takes place during the execution of the programs.

4.2.2 MS-Access 7.0

MS-Access is an relational database management system (RDBMS). It supports multi-user environment, more than one person might be working with the same time . We may occasionally conflict with others as we work. MS-Access products are based on a concept known as the "client/server technology". This concept involves segregating the processing of an application between the two systems. One performs all activities related to the database server and other performs activities that help the user to interact the application (client).

A client or front-end database application also interacts with the database by requisition)

Ms-Access provides record locking facilities, where by other users can't change the records in the under laying table when one user is editing it. Giving one user exclusive access to a record locking.

Ms-Access helps us to keep track of the status of records as we edit them, and sure we are using the latest data. When two or more people try to edit the same record, Microsoft Access displays massages that help us to resolve the conflicts.

4.2.2.1 Advanced features of ms-access:

Microsoft Access 97 offers many new and improved features to help you create powerful database applications like.

- New objects, properties, methods, and other language elements.
- Accessing the internet or an intranet from your application.
- Creating custom objects with class modules.
- Customizing menus and toolbars in your application.
- Removing source code from your application.
- Replicating only a specified part of a database.

- Replicating only a specified part of a database.
- Working with version3.5 of the Microsoft jet database engine.
- Using new features in the module window.
- Using the object browser as a reference for objects and their numbers.
- Using DAO to access ODBC database without loading the Microsoft jet database engine.
- Creating a tabbed dialog box or multiple-page form with the tab control.
- Setting references programmatically.
- Using the enhanced debug window.
- Improving compilation performance

4.2.2.2 Data Types:

Text : It is used to store text or combination of text and numbers that don't require calculations, such as phone number, pin code etc.. This data type can store up to 255 characters.

Memo: It is used to store lengthy or combinations of text and numbers. It allows storing up to 65,535 numbers.

Number: It stores numbers from -32,768 to 32,7679 (No fractions) storage size of this field type is 2 bytes.

Data/time: This field is used to store data and time values. The field size of this data type is 8 bytes.

Currency: It is used to store currency values and numeric data used in mathematical calculations involving data with one to four decimal places. The field size of this data type is 8 types.

Auto Number: It is used to store a unique sequential number or random assigned by Microsoft Access. Whenever a new record is added to the table. Auto number field can't be updated. The Storage size of this data type is four bytes.

4.2.3 VISUAL BASIC 6.0

Visual Basic is an ideal programming language for developing sophisticated professional applications for Microsoft windows. "Visual" refers to the method used to create the graphical user interface (GUI), that uses illustrations, rather than writing numerous lines of code to describe the appearance, function and location of interface elements. "Basic" refers to the BASIC programming language, a widely preferred

language by many programmers for its simplicity. Microsoft corporation created the enhanced version of BASIC called visual basic for windows.

4.2.3.1 Integrated Developing Environment

The integrated development environment is one of the significant advantages in Visual Basic 6.0 is the Integrated Development Environment (IDE). It is called integrated because we can access virtually all of the development tools that we need from one screen called an interface. The IDE is commonly referred to as the design environment, or the program.

Visual basic IDE is made up of a number of components

- Menu bar
- Tool bar
- Project explorer
- Properties window
- Form layout window
- Toolbox
- Form designer
- Object browser

With visual basic the following application can be developed.

- Standard Exe
- ActiveX Exe
- ActiveX DLL
- ActiveX Control
- Data project
- DHTML Application
- IIS application
- ActiveX document Exe
- ActiveX document DLL
- VB Enterprise edition Controls

4.2.3.2 Event Driven Programming

Visual Basic programs are built around events. Events are various things that can happen in a program in procedural language, an application written is executed by checking for the program logically through the program statements, one after the another. For a temporary phase, the control may be transferred to some other point in the program.

While in an event driven application, the program statements are executed only when a particular event calls a specific part of the code that is assigned to the event.

DEVELOPING AN APPLICATION

An application can be created with the project. A project is a collection of flies that are used to build an application. Writing a visual program involves the following steps.

Visual programming step : It involves designing an application with various tools that come along with visual basic package.

Code programming step : It involves writing programs using text editor.

ADVANTAGE OF THIS VERSION:

In previous versions of Visual Basic, the IDE was designed as a single document interface, each window is a free-floating window that is contained within a main window and can move anywhere on the screen as long as visual is the current applications. But in Visual Basic 6.0, the IDE is in a multiple document interface (MDI) format. In this format, the windows associated with the project will stay within a single container known as the parent. Code and form-based windows will stay within the main container form in the IDE.

CHAPTER 5
SYSTEM IMPLEMENTATION

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 System usage

A crucial phase in the system development is the successful implementation of the new system. Implementation is the process of converting a new system design in to an operational one. This involves creating computer compatible files to store the data, converting the data flow diagrams in to coding and documentation.

EFFICIENCY ANALYSIS OF SUBMERSIBLE PUMP MOTOR IMPLEMENTING SOFTWARE

It has undergone the formal process of implementation in the same manner as every other system would undergo. The procedural aspects which were followed are:

- Testing
- Documentation

5.2 System testing

Testing is a vital process to the success of the system. Inadequate testing or non-testing leads to error that may not appear until months latter. Hence the aim of testing is to provide bug free software and a secured system.

The system on a whole were tested for the following:

- ✓ Validation of inputs
- ✓ Referential integrity test
- ✓ Sequential tests
- ✓ Consistency of application

Testing is a vital to the success of the system. System testing makes a logical assumption that if all parts of the system are correct, the system will be successfully achieved.

The objectives of testing is to discover errors. To full fill these objectives a series of tests were planned and executed. The approach is to test each entity with successfully larger ones, up to the system level.

In the case of efficiency analysis of submersible pump motor implementing software two types of tests were conducted

1. Unit testing
2. Integrated testing.

In the unit testing each individual program were tested using the test data. The output as per the requirements was found satisfactory.

CHAPTER 6
CONCLUSION

CHAPTER 6

CONCLUSION

The project entitled **"Software Analysis of the Efficiency of Submersible Pump Motor"** has been successfully developed to satisfy the testing department to maintain the details of the manufactured motor and to report the efficiency, which matches the ISI standards. If any mismatch is found then the reasons for the cause of the efficiency crossing the prescribed range is displayed.

This software is easily accessible and is found to be more effective and efficient than the existing software. This software eliminates all the drawbacks of existing software prevailing in the company.

REFERENCES

REFERENCES

1. Gary Cornell, "Visual Basic 6.0 from ground up", Tata Mcgraw-hill edition, 1999.

2. Alxenander. S. Langsdorf, "Theory of Alternating Current Machinery" TMH edition 1974

3. Dr. P. N. Modi, Dr. S. Seth, "Hydraulics and Fluid Mechanics" Tata Mcgraw-hill edition, 1989.

4. Website : www.polywin.com

APPENDIX

APPENDIX

Samples tables

TABLE 1 VALUES OF PERFORMANCE CHARACTERISTICS OF TWO POLE THREE PHASE SUBMERSIBLE PUMP MOTOR

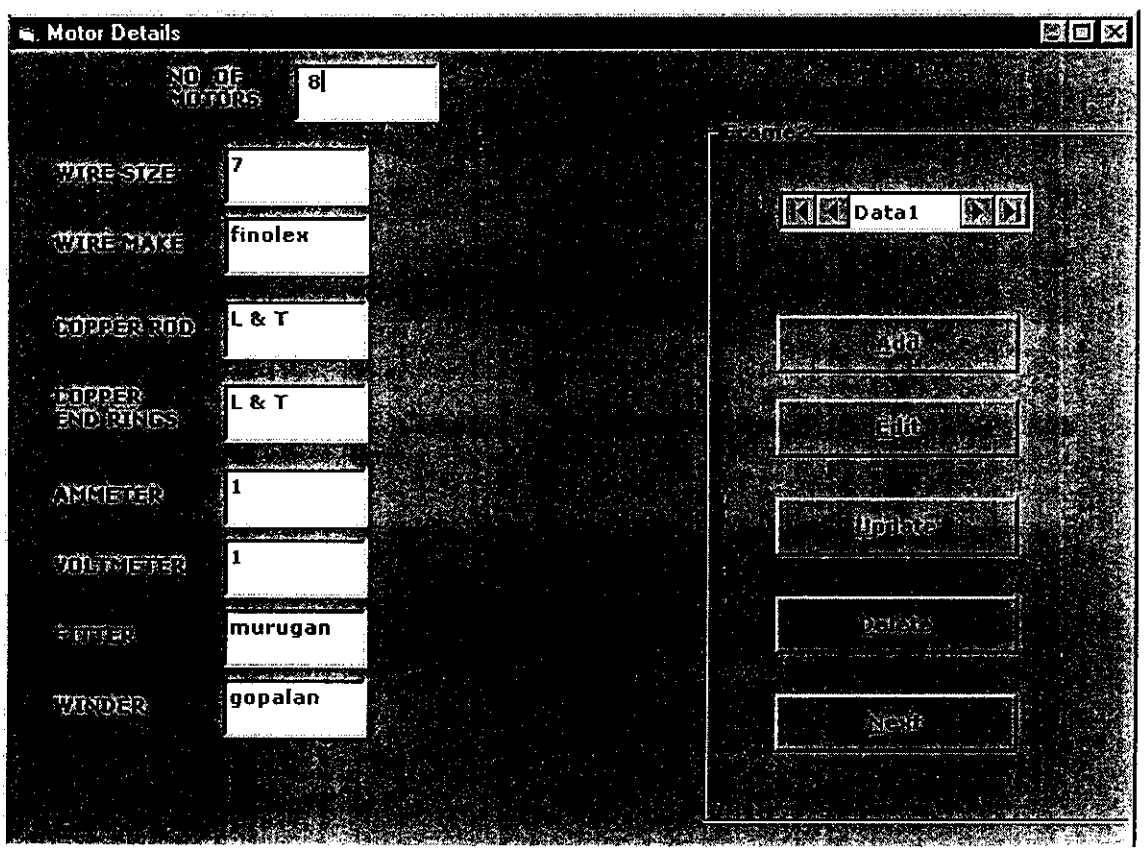
Rated Output	Max. full load speed	Max. full load current	Min. starting torque	Nominal efficiency of the motors suitable for bore size and max. OD		
				100 mm Or 96 mm	150 mm Or 142 mm	200 mm Or 192 mm
1.1	2.74	3.25	125	60	62.6	-
1.5	2.74	4.5	125	65.2	70.4	-
2.2	2.76	6.5	125	67.8	71.3	-
3.0	2.76	8.5	125	67.8	71.3	73
3.7	2.78	10	125	68.7	72.2	73.9
4.5	2.78	12	125	-	73.9	75.7
5.5	2.8	14	160	-	76.5	78.3
7.5	2.8	19.5	160	-	77.4	79.1
9.3	2.82	25	160	-	78.3	80
11	2.82	29	160	-	69.1	80.9
13	2.84	34	170	-	80	81.7
15	2.84	39	170	-	80.9	82.6

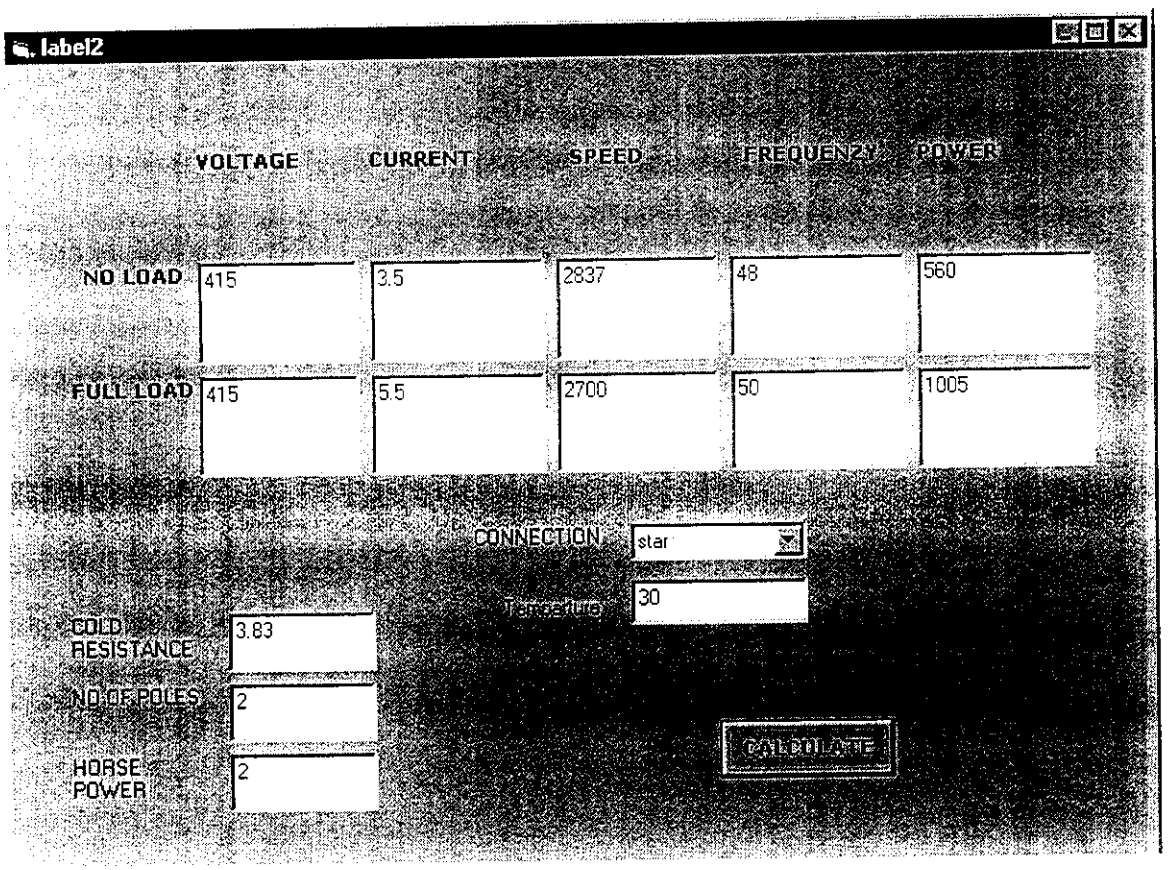
NOTE : For motors of output ratings below 1.11 KW and above 15 KW, the performance values shall be declared by the manufacturer.

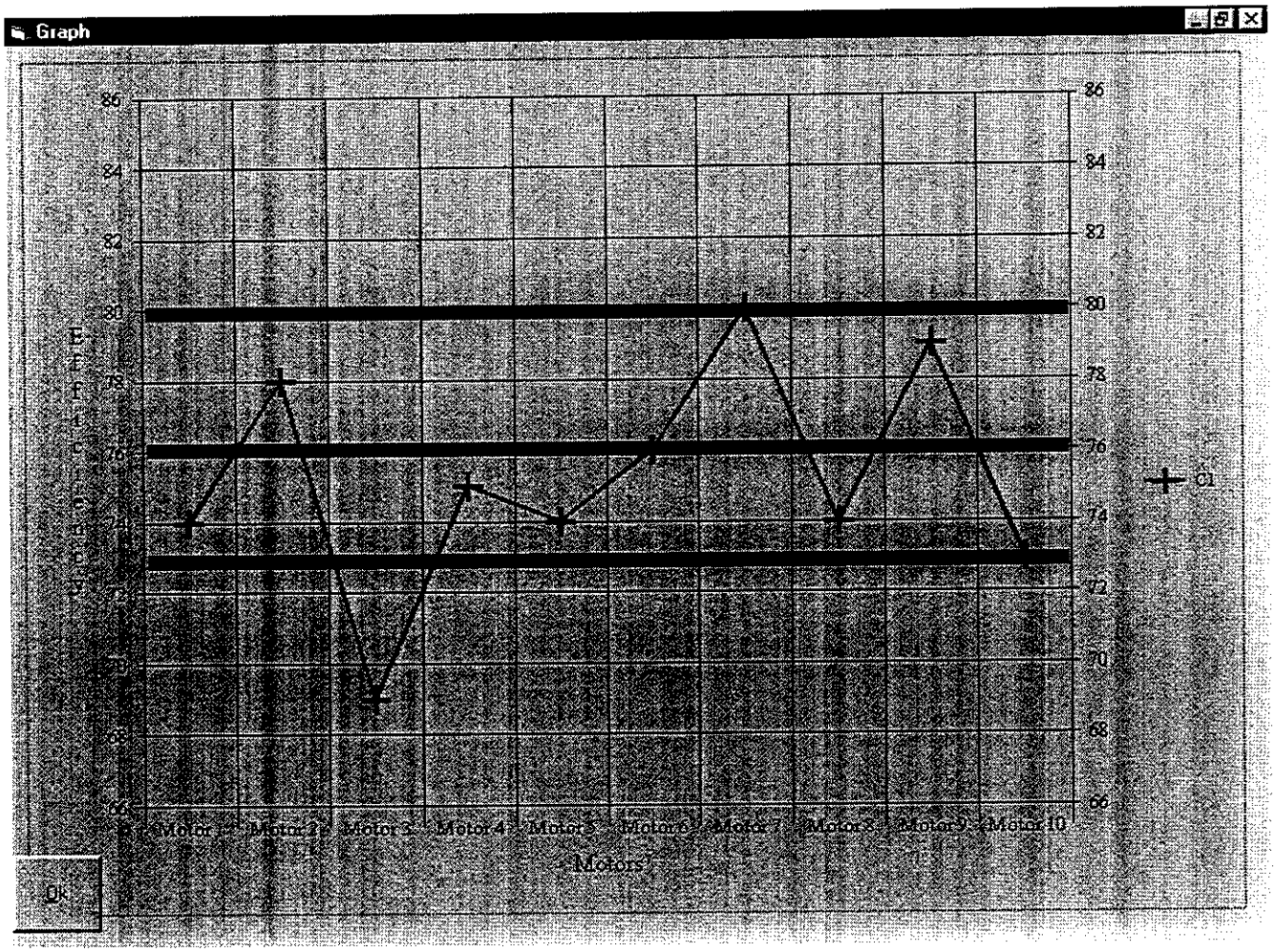
TABLE 2 THE FOLLOWING ARE THE DIFFERENT WIRE SIZE AVAILABLE FOR DIFFERENT HORSE POWER AND CURRENT RATINGS OF SUBMERSIBLE PUMP MOTOR

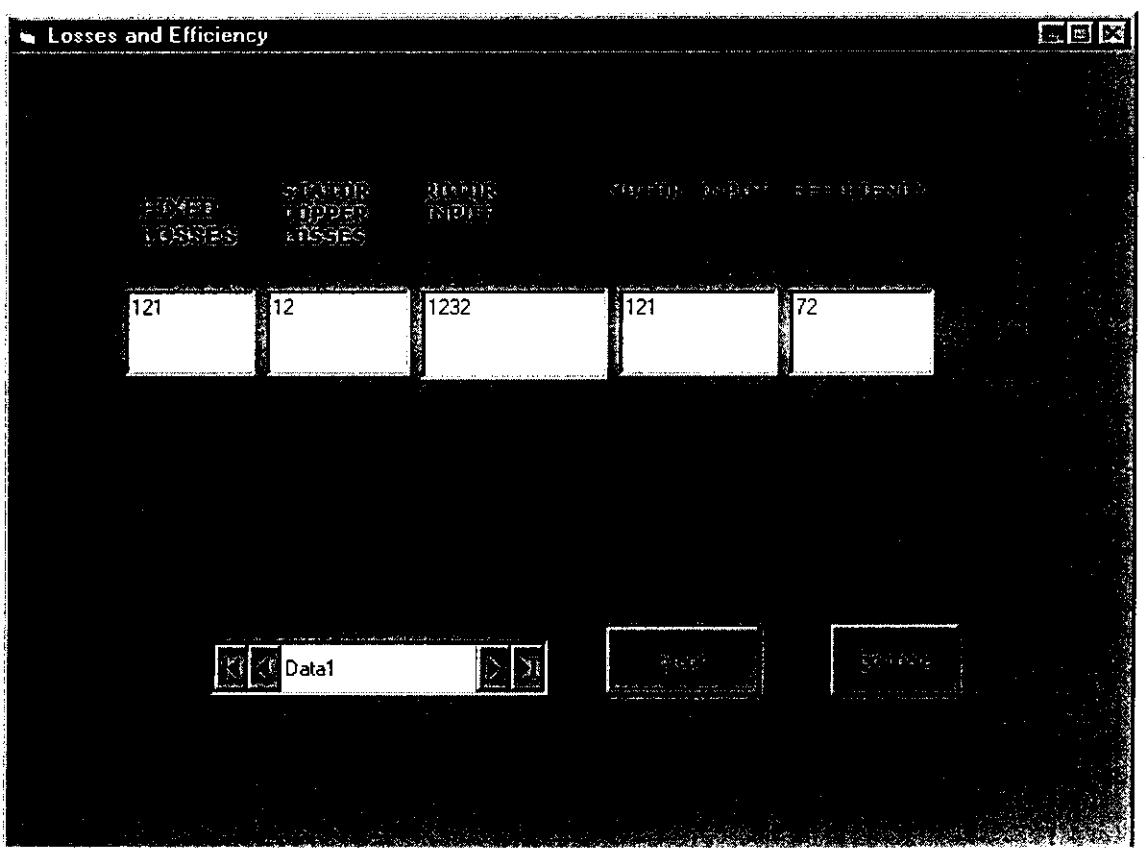
conductor dia nominal	insulation thickness nominal	overall dia (max)	nominal conductors resistance (ohms/km)
0 .50	0.20	0.95	87.80
0.63	0.20	1.05	55.30
0 .71	0.20	1.15	43.55
0 .80	0.20	1.25	34.30
0..90	0.20	1.35	27.10
1.00	0.20	1.45	21.95
1.12	0.20	1.55	17.50
1.18	0.25	1.78	15.77
1.32	0.25	1.92	12.60
1.40	0.25	2.00	11.20
1.50	0.25	2.10	9.76
1.60	0.25	2.20	8.58
1.70	0.25	2.30	7.60
1.80	0.25	2.40	6.78
1.90	0.25	2.50	6.08
2.00	0.25	2.60	5.49
2.12	0.25	2.72	4.88
2.24	0.25	2.84	4.38
2.36	0.25	2.96	3.94
2.50	0.25	3.10	3.51

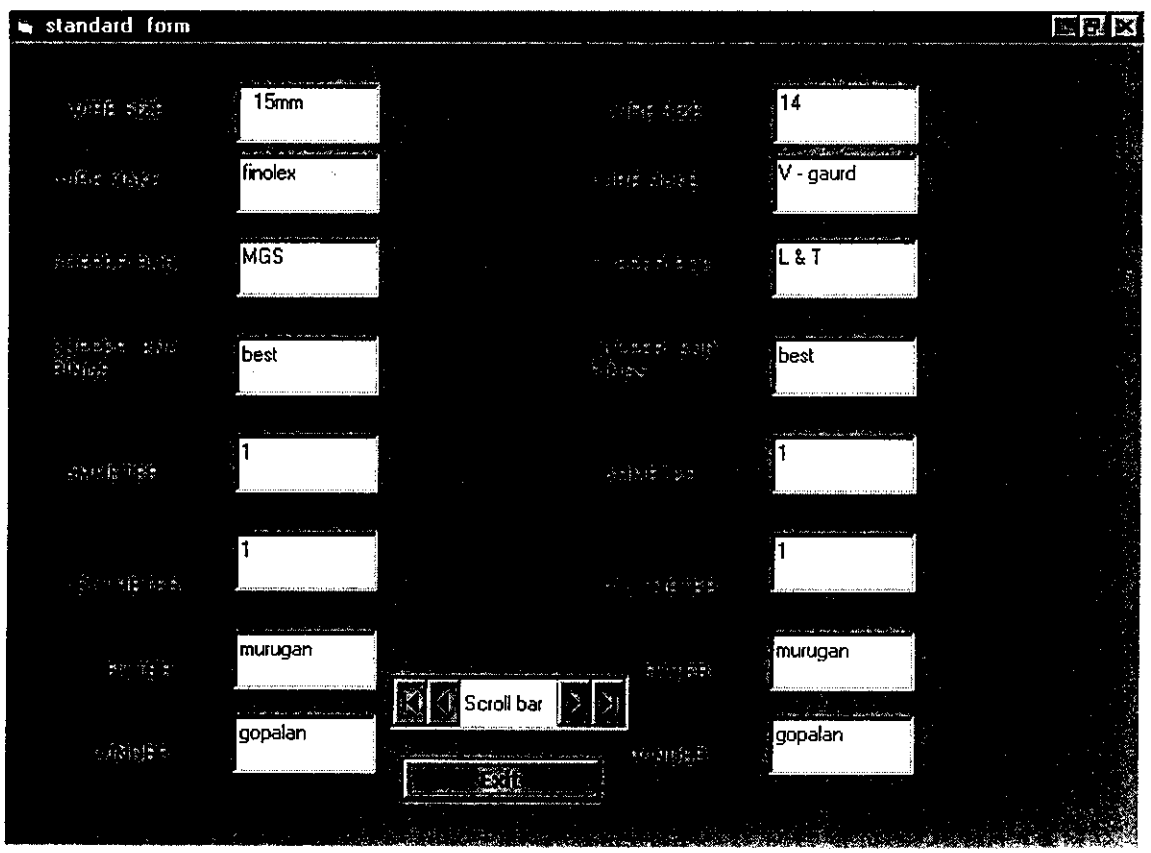
Sample Forms




label2
VOLTAGE
CURRENT
SPEED
FREQUENZY
POWER
NO LOAD
415
3.5
2837
48
560
FULL LOAD
415
5.5
2700
50
1005
CONNECTION
star
Temperature
30
COLD RESISTANCE
3.83
NO OF POLES
2
HORSE POWER
2
CALCULATE


Graph
Efficiency
Motors
Motor 1
Motor 2
Motor 3
Motor 4
Motor 5
Motor 6
Motor 7
Motor 8
Motor 9
Motor 10
C1
Ok


Losses and Efficiency
121
12
1232
121
72
Data1


standard form
15mm
finolex
MGS
best
1
1
murugan
gopalan
14
V - gaurd
L & T
best
1
1
murugan
gopalan
Scroll bar
Exit

Sample Codes

Motor details

```
Option Explicit
Private Sub Command1_Click()
Data1.Recordset.AddNew
Text1.Text = ""
Text2.Text = ""
Text3.Text = ""
Text4.Text = ""
Text5.Text = ""
Text6.Text = ""
Text7.Text = ""
Text8.Text = ""
Text9.Text = ""
Command1.Enabled = False
Command3.Enabled = True
End Sub

Private Sub Command2_Click()
Data1.Recordset.Edit
Command3.Enabled = True
End Sub

Private Sub Command3_Click()
Data1.Recordset.Update
Command1.Enabled = True
Command3.Enabled = False
```

```
End Sub

Private Sub Command4_Click()
Data1.Recordset.Delete
Text1.Text = ""
Text2.Text = ""
Text3.Text = ""
Text4.Text = ""
Text5.Text = ""
Text6.Text = ""
Text7.Text = ""
Text8.Text = ""
End Sub

Private Sub Command5_Click()
Form1.Hide
Form2.Show
End Sub

Private Sub Form_Load()
Command1.Enabled = True
Command3.Enabled = False
Text1.Text = ""
Text2.Text = ""
Text3.Text = ""
Text4.Text = ""
Text5.Text = ""
Text6.Text = ""
Text7.Text = ""
Text8.Text = ""
```

```
Text9.Text = ""
End Sub

Private Sub Text9_LostFocus()
n = Val(Text9.Text)
End Sub
```

Input Details

```
Private Sub Command1_Click()
v0 = Trim(Text1.Text)
vl = Trim(Text5.Text)
i0 = Trim(Text2.Text)
il = Trim(Text6.Text)
n0 = Trim(Text3.Text)
nl = Trim(Text7.Text)
f0 = Trim(Text4.Text)
fl = Trim(Text8.Text)
w0 = Trim(Text15.Text)
wl = Trim(Text14.Text)
p0 = Trim(Text11.Text)
r0 = Trim(Text10.Text)
hp0 = Trim(Text12.Text)
t0 = Trim(Text13.Text)
R01 = ((235 + 45) / (235 + t0)) * ro
f = 50
ns = 120 * f / p0
If Combo1.Text = "star" Then
fixedloss = (w0 - (3 * i0 * i0)) * R01
Else
fixedloss = (w0 - (i0 * i0)) * R01
End If
statorcopperloss = il * il * R01
rotorip = wl - (fixedloss + statorcopperloss)
motorop = (rotorip * nl * 0.995) / ns
effi = (motorop / wl) * 100
```

```
Data1.Recordset.AddNew
Data1.Recordset(0) = i
Data1.Recordset(1) = effi
Data1.Recordset(2) = statorcopperloss
Data1.Recordset(3) = motorop
Data1.Recordset(4) = rotorip
Data1.Recordset(5) = fixedloss
Data1.Recordset.Update
Text1.Text = ""
 Text5.Text = ""
 Text2.Text = ""
 Text6.Text = ""
 Text3.Text = ""
 Text7.Text = ""
 Text4.Text = ""
 Text8.Text = ""
 Text15.Text = ""
 Text14.Text = ""
 Text11.Text = ""
 Text10.Text = ""
 Text12.Text = ""
 Text13.Text = ""
i = i + 1
If i = n1 Then
 res = MsgBox("Do you want to enter more data?", vbYesNo)
 If res = vbYes Then
  n = 0
  i = 0
  Unload Me
  Form1.Show
```

```
  Form1.Text9.SetFocus
ElseIf res = vbNo Then
 Unload Me
 res1 = MsgBox("Do you want to see the graph?", vbYesNo)
 If res1 = vbYes Then
 Form2.Hide
 Form5.Show
 Else
 Form3.Show
 End If
End If
Else
Unload Me
Form1.Show
End If
End Sub
Private Sub Form_Load()
n1 = Val(Form1.Text9.Text)
End Sub
```

Losses and Efficiency

```
Private Sub Command1_Click()
Form3.Hide
Form5.Show
End Sub

Private Sub Command2_Click()
Form3.Hide
Form4.Show
End Sub
```

Standard Form

```
Private Sub Command1_Click()
Form1.Show
Form4.Hide
End Sub
```

Graph

```
Private Sub Command1_Click()
Form5.Hide
Form3.Show
End Sub

Private Sub Form_Activate()
ro = 1

While (Data1.Recordset.EOF = False)
MSChart1.Column = 1
MSChart1.Row = ro
MSChart1.Data = Data1.Recordset(1)
ro = ro + 1
Data1.Recordset.MoveNext
Wend
End Sub
```

Sample Data Base

Table name: effi

Purpose : Has details about losses and efficiency

Field name	*Field type*	*Width*
Motorno	integer	2
Effi	long	4
Staloss	long	4
Motorop	long	4
Rotorip	long	4
Fixedloss	long	4

Table name: ws

Purpose : Has details about motor

Field name	*Field type*	*Width*
Wiresize	double	8
Wiremake	text	50
Copperrod	text	50
Copperendring	text	50
Ammeter	integer	2
Voltmeter	integer	2
Fitter	text	50
Winder	text	50