EVALUATION OF FIBERS USED IN FISHING LINES

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JUDUL: EVALUATION OF FIBERS USED IN FISHING LINES

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I certify that the project entitled *"Evaluation of Fibers Used in Fishing Lines"* is written by *Mohammad Muzahir Bin Ahmad*. I have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. I herewith recommend that it be accepted in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering.

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EVALUATION OF FIBERS USED IN FISHING LINES

MOHAMMAD MUZAHIR BIN AHMAD

Thesis submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

DECEMBER 2010

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature

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I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature

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Date: 6TH DECEMBER 2010

Dedicated to my beloved family & friends

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ABSTRACT

This project is about the experiments conducted to prove that most of the commercial fishing lines exhibited a higher breaking strength than the actual breaking strength. Besides, this project also about the investigation of the reason why fishing line that has been used can not stand for prolonged of time. So this experiment is done by stretching a test of various types and brand names of fishing lines that have in the market nowadays and subsequently to discuss and make conclusions on issues that related to the results obtained from the study. Experiments are carried out according to Malaysian Standard that was prepared by the Technical Committee on Yarns, Threads and Twines under the authority of the Textile and Clothing Industry Standards Committee. It is based on The International Standard ISO 2062 'Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)' with reference being made to the British Standard BS 1932 : Part 1 : 1965 'Methods of testing the strength of yarns form packages - Part 1 : Determination of breaking load and extension'. This project has three main objectives that must achieve that are to design a suitable of tensile test rig for fishing line and has prescribed standard test method for tensile properties of fiber that used in fishing lines, identify the mechanical properties of fishing lines and investigate the effect of environmental exposure that subjected to freshwater, seawater or salt water and natural environment expose. Based on the result of from the experiments, it is found that the specimens that were exposed to freshwater, saltwater and the natural environmental give effect to the degradation of strength of fishing line. It means that water and uv light are the factors that cause the strength of fishing lines become lower. That is the reason why fishing line that has been used can not stand for prolonged of time.

ABSTRAK

Projek ini adalah berkaitan eksperimen-eksperimen yang dijalankan untuk membuktikan bahawa kebanyakan tali tangsi yang dijual di pasaran mempamerkan kekuatan putus yang lebih tinggi daripada kekuatan putus yang sebenar. Selain itu, projek ini juga adalah untuk menyiasat apakah sebab yang menyebabkan kekuatan tali tangsi yang telah digunakan boleh merosot. Jadi kajian ini dilakukan dengan membuat ujian keregangan terhadap pelbagai jenis dan jenama tali tangsi yang ada di pasaran dan seterusnya dapat membincangkan dan membuat kesimpulan terhadap masalah yang berkaitan berdasarkan keputusan yang diperoleh daripada hasil kajian. Eksperimen-eksperimen yang dijalankan adalah mengikut Malaysian Standard yang disediakan oleh “Technical Committee on Yarns, Threads and Twines” di bawah kuasa “Textile and Clothing Industry Standards Committee”. Eksperimen ini merujuk kepada “The International Standard ISO 2062 ‘Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)’ yang berpandukan dengan “British Standard BS 1932 : Part 1 : 1965 ‘Methods of testing the strength of yarns form packages - Part 1 : Determination of breaking load and extension”. Kajian ini mempunyai tiga objektif utama iaitu mereka bentuk satu komponen mesin yang sesuai dan mengikut piawaian kaedah kajian yang ditetapkan untuk mengkaji kekuatan regangan tali tangsi, mengenalpasti ciri-ciri mekanikal bagi tali tangsi dan menyiasat pengaruh pendedahan persekitaran seperti air bersih, air laut atau air garam dan persekitaran sekeliling terhadap tali tangsi. Berdasarkan keputusan yang diperoleh daripada eksperimen yang telah dijalankan, didapati terbukti bahawa kekuatan tali tangsi yang dijual di pasaran adalah lebih tinggi daripada kekuatan sebenarnya. Selain itu, didapati bahawa tali tangsi yang telah terdedah kepada air bersih mahupun air garam serta terdedah kepada persekitaraan sekeliling telah mengalami kemerosotan kekuatannya. Ini bermakna bahawa air dan sinaran uv adalah factor yang menyebabkan kekuatan tali tangsi merosot. Ini juga adalah sebabnya tali tangsi yang pernah digunakan tidak dapat bertahan lama.

TABLE OF CONTENTS

CHAPTER 3 METHODOLOGY

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CRE	Constant-rate-of-specimen-extension
CRL	Constant-rate-of-loading
CRT	Constant-rate-of-transverse
Eq.	Equation
ISO	International Organization for Standardization
PA	Polyamide
PE	Polyethylene
PVDF	Polyvinylidene fluoride
SIRIM	Standards and Industrial Research Institute of Malaysia
UTS	Ultimate tensile strength
UV	ultra violet
Vs.	versus

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Fibers defined as a class of material whose length is much greater than its cross-sectional dimensions. According to the length, fibers are continuous filaments or are in discrete elongated pieces which are similar to lengths of thread. Fibers are often used in the manufacture of other materials. Fishing lines is made from some classes of fiber based on synthetic polymers such as nylon, polyethylene and fluorocarbon. Thus, this project is about the experiments conducted to prove that most of the commercial fishing lines exhibited a higher breaking strength than the actual breaking strength. Often, users will be confused and disappointed because they always fail in the 'battle' with their catch because the used line broke even though they used the stronger and expensive line. So this experiment is done by stretching a test of various types and brands of fishing lines that have in the market nowadays and subsequently to discuss and make conclusions on issues that related to the results obtained from the study. Experiments are carried out according to Malaysian Standard that was based on The International Standard ISO 2062 ‘Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)’.

1.2 PROBLEM STATEMENT

i. Commercial retail fishing line of stated pound-test is higher than the actual pound-test. Often, users will be confused and disappointed because the line that they used always broke even though they used the stronger and expensive line.
ii. Fishing line users are confused why they can not use the same line in prolonged of time. The experiments must be done to investigate the factors that effect the degradation of fishing lines.

1.3 PROJECT OBJECTIVES

i. Design and fabricate tensile test rig for fishing line testing.
ii. Estimate the mechanical properties of fishing lines.
iii. Investigate the influence of water and uv light to fishing line degradation.

1.4 PROJECT SCOPES

i. The experiments tests were performed in accordance with the ISO 2062 ' Methods For The Determination Of Breaking Load Of Yarns From Packages – CRL, CRE and CRT Testers'
ii. Types of fishing lines that being tested are nylon, polyethylene, and fluorocarbon lines.
iii. The brand name of fishing lines that being tested are Fisherman, Berkley, Exory, I-Fish, Seahawk, Conato, Tomman, Abu Garcia, Nelayan, Daiwa, Triple Fish, P-Line, Seaguar, Stren, Otoro, Besd Internasional, Cortland Master, Power Pro Spectra, Ajiking and Ohero.
iv. Fishing lines that being tested are subjected to freshwater, salt water, and natural environmental exposure.

1.5 PROJECT FLOW CHART

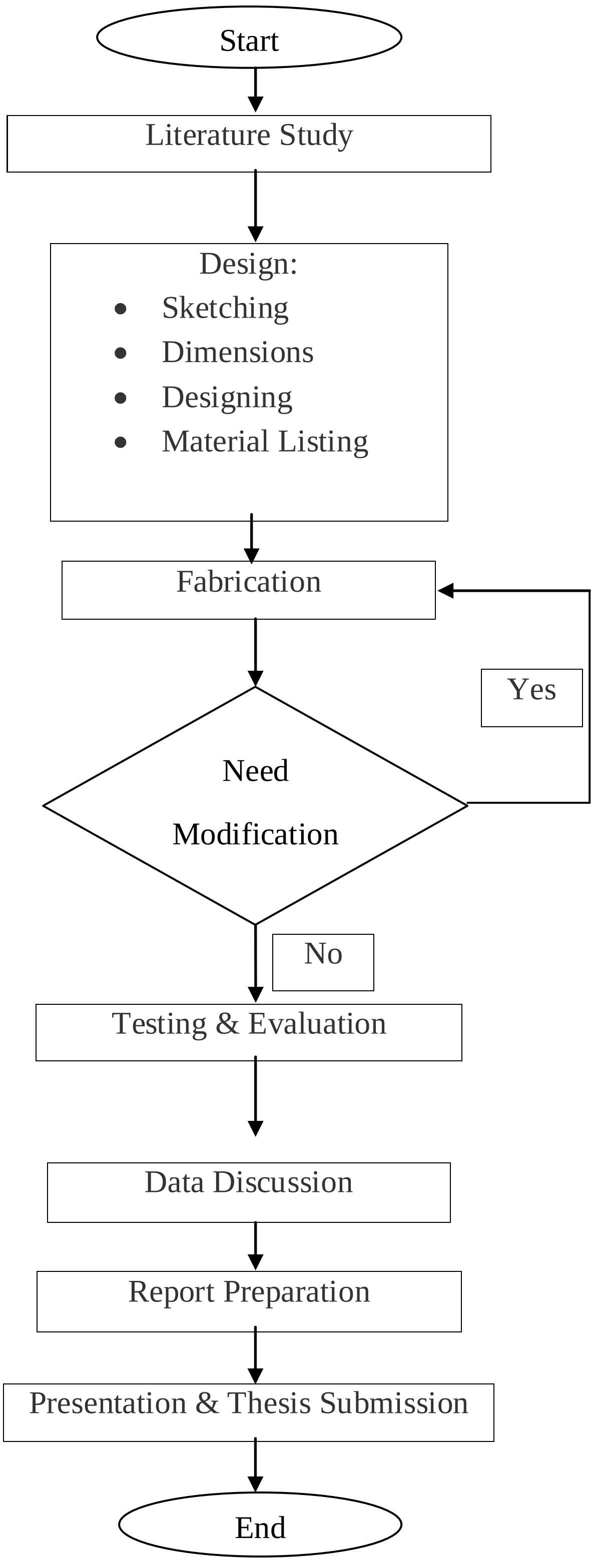

Figure 1.1: Project flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Fishing lines is made from some classes of fiber based on synthetic polymers such as nylon, polyethylene and fluorocarbon. Tensile test is a common and important test that provides a variety of information about the fibers used in fishing lines that being tested, including the elongation, yield point, modulus of elasticity, toughness, tensile strength, and ultimate strength of the material. This project is focus on doing the tensile test for the fishing line specimens. The experiments must carried out according to Malaysian Standard that was based on The International Standard ISO 2062 'Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)'. Furthermore, the appropriate of tensile test rig must be choosing to avoid the premature specimen failure.

2.2 TESTING STANDARD

2.2.1 ISO 2062 'Method For Determination Of Breaking Load And Elongation At The Breaking Load Of Single Strands-(CRL, CRE And CRT Testers)'.

This testing standard had been approved by the Textile and Clothing Industry Standards Committee and endorsed by the Council of the Standards and Industrial Research Institute of Malaysia (SIRIM) and was published under the authority of the SIRIM Council in September, 1976.

The method authorizes the use of three typed of testing machines in common use for measuring the breaking load and elongation at the breaking loads of yarns. The types of machines are:

i. Constant-rate-of-load (CRL). This method is run by subjected the specimen to an increasing load at a predetermined constant rate such that the average time-to-break will fall within the specified limits.

ii. Constant-rate-of-specimen-extension (CRE). This method is run by elongating the specimen at a predetermined constant rate such that the average time to reach the breaking elongation will fall within the specified limits.

iii. Constant-rate-of-traverse of the driver clamp (CRT), with pendulum or spring weighing mechanism. This method is run by subjected the specimen to an increasing load by traversing the driven clamp at a constant rate such that the average time-to-break will fall within the specified limits.

2.2.2 Scope

This International Standard specified a method for the determination of the breaking load & breaking elongation of various types of yarn is design primarily for yarn in package form but can also be used for single strands extracted from a fabric. So, this method is applicable to single yarns of several types of fishing lines which are monofilament and multifilament lines.

Optional procedures for determining the breaking load are included Option 1 that covers test based on specimens in equilibrium with the standard atmosphere for testing and Option 2 that covers tests based on specimens in wet state.

This project is run by follow the optional experiment procedures of Option 1A which is constant-rate-of-specimen-extension (CRE). Based on this method, the fishing line that is being tested is elongated at a constant rate such that the average time to reach the breaking elongation will fall within the specified limits.

The experiment procedures of Option 2 also being follow to run the experiments for determination of the breaking load of fishing lines that are subjected to freshwater, salt water and the natural environmental exposure.

2.2.3 Mechanical Properties

i) Stress & Strain

a. The tensile stress on a material is defined as the force per unit area as the material is stretched. The cross-sectional area may change if the material deforms as it is stretched, so the area used in the calculation is the original undeformed cross-sectional area A_o as shown in Eq. 2.1.

$$\sigma = \frac{Force}{\mathrm{Ao}} \qquad (2.1)$$

The units of stress are the same as those of pressure. In the polymer literature, stress often is expressed in terms of psi (pounds per square inch).

b. The strain is a measure of the change in length of the sample. The strain commonly is expressed in one of two ways as shown in Eq. 2.2 and Eq. 2.3.

Elongation: $$\delta = \frac{\Delta L}{L_{\circ}} \qquad (2.2)$$

Extension ratio: $$\varepsilon = \ln\left(\frac{Li}{Lo}\right) \qquad (2.3)$$

ii) Ultimate Tensile Strength

One of the properties you can determine about a material is its ultimate tensile strength (UTS). This is the maximum load the specimen sustains during the test as shown in Figure 2.1. The UTS may or may not equate to the strength at break. This all depends on what type of material you are testing whether brittle, ductile, or a substance that even exhibits both properties. And sometimes a material may be ductile when tested in a lab, but, when placed in service and exposed to extreme cold temperatures; it may transition to brittle behavior.

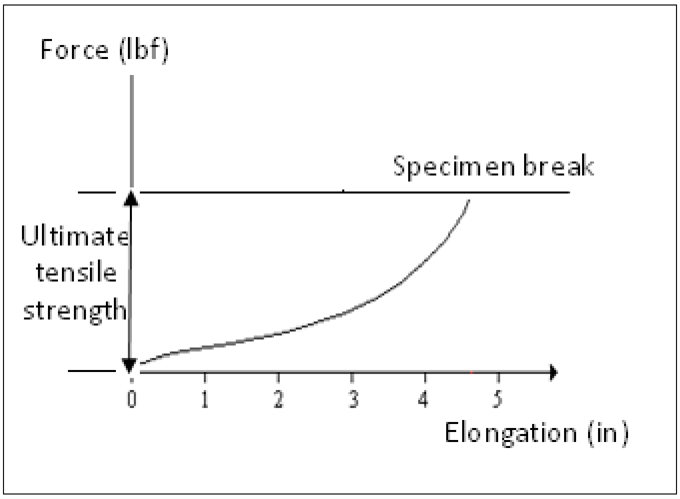

Figure 2.1: Ultimate tensile strength

iii) Ultimate Elongation

The elongation-to-break is the strain on a sample when it breaks as shown in Figure 2.2. This usually is expressed as a percent. The elongation-to-break sometimes is called the ultimate elongation.

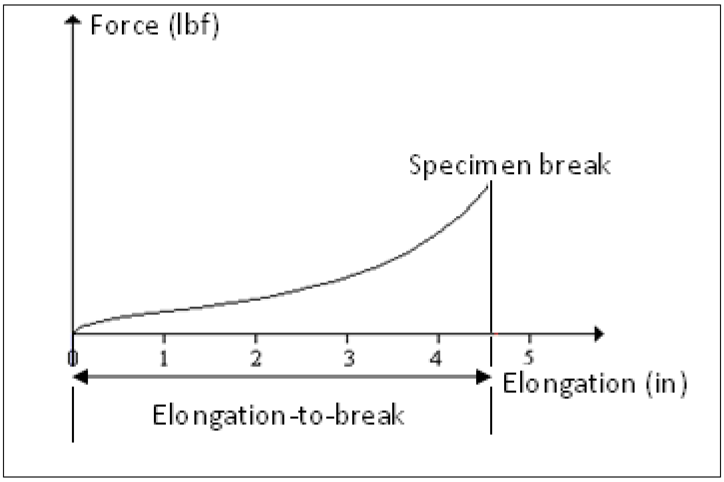

Figure 2.2: Ultimate elongation

2.3 TENSILE TEST SPECIMEN

2.3.1 Universal Testing Machine

Universal testing machines are most commonly used for static testing in a tensile or compression mode within a single frame as shown in Figure 2.3. They are also referred to as pull testers. Capacities for these systems range from low-load forces of 112 lbf (0.5 kN) up to high-capacity 135,000 lbf (600kN) test frames. These systems are frequently configured for automated testing.

Figure 2.3: Universal testing machine

Source: http://www.instron.us

2.3.2 Tensile Test Rig

The appropriate of tensile test rig must be choosing to avoid the premature specimen failure. There are a variety of grips that are appropriate for single strand fibers such as O-Ring Fiber Clamping Grips and Cord and Yarn Style Grips.

i) O-Ring Fiber Clamping Grips

It is designed to hold very small diameter fiber specimens during tension testing. Special considerations are built into the design, where the U-shaped bend provides sufficient area for specimen loading as shown in Figure 2.4.

Figure 2.4: O-Ring fiber clamping grips

Source: http://www.instron.us

ii) Pneumatic cord and yarn grips

Pneumatic cord and yarn grips as shown in Figure 2.5 are provide a convenient method for clamping fiber, cord, yarns and fine braided wires to reduce the problem of jaw breaks associated with testing these materials. A specially designed horn with a smooth finish and a contoured surface with a graduated cam allow for easy loading and a stress reduced clamping area on the specimen. The clamping mechanism can be activated either automatically or through a foot switch. This allows hands-free grip operation enabling the specimen to be held with both hands, for easy loading. Pneumatic cord and yarn grips provide selectable clamping force to accommodate different materials and excellent follow-up action which compensates for decay of the holding force due to specimen creep.

Figure 2.5: Pneumatic cord and yarn style grips

Source: http://www.instron.us

2.4 TYPE OF FISHING LINES

2.4.1 Monofilament Line (Polyamide nylon)

Fishing line generally made from synthetic fibers that come from synthetic materials such as petrochemicals. Synthetic fibers account for about half of all fiber usage, with applications in every field of fiber and textile technology. Polymer fibers are a subset of synthetic fibers, which are based on synthetic chemicals (often from petrochemical sources) rather than arising from natural materials by a purely physical process. The classes of fiber based on synthetic polymers have been evaluated as potentially valuable commercial fishing line products are Polyamide (PA) nylon, Polyethylene (PE), eventually with extremely long chains (e.g. Dyneema or Spectra), and Polyvinylidene Fluoride (PVDF).

Monofilament is popular as a line material because of its low memory and suppleness, which make it easy to cast and handle. Most fishing line is made from monofilament because of its strength, availability in all pound-test kinds, and low cost. It also comes in many different colors such as white, green, blue, clear, and fluorescent. Monofilament is made by melting and mixing polymers and then extruding through tiny holes, forming strands of line, which is then spun into spools of various thicknesses. The extrusion process controls not only the thickness of the line but also the pound test of the line.

Monofilament is not advisable for deepwater fishing since it can absorb water resulting in loose knots, and its sensitivity can decrease when it is wet. Monofilament degrades with time and can weaken when exposed to heat and sunlight. When stored on a spool for a long time, it may come off the fishing reel in coils or loops. It is advisable to change monofilament line at regular intervals to prevent degradation. The example of monofilament line is shown in Figure 2.6.

Figure 2.6: Monofilament line

2.4.2 Braided Line (Polyethylene)

Braided line was one of the of earliest types of fishing line, and in its modern incarnations it is still very popular in some situations because of its high knot strength, lack of stretch, and great overall power in relation to its diameter. Braids were originally made from natural fibers such as cotton and linen, but natural fiber braids (with the very rare exception of braided silk) have long since been replaced by braided or woven fibers of a man-made materials like Dacron, Spectra or Dyneema into a strand of line. Braided fishing lines tend to have good resistance to abrasion. Their actual breaking strength will commonly well exceed their pound-test rating.

One drawback of braided lines is that they are generally opaque in the water, and thus visible to fish. Hence, it is common to attach a monofilament at the end of the braided fishing line to serve as a leader and to reduce the high visibility of the braided fishing line.

This type of fishing line is expensive; sometimes four times the cost of equivalent monofilament. This can become a considerable expense, especially considering that the line is so thin that you need more of it to fill a reel spool.

Sometimes, a backing of monofilament or other line is used under the braided line on the spool. The example of braided line is shown in Figure 2.7.

Figure 2.7: Braided line

2.4.3 Fluorocarbon Line (Polyvinylidene Fluoride)

Compared to most monofilament lines, which are made primarily of extruded nylon, fluorocarbon is manufactured from extruded polyvinylidene fluoride. Although the extrusion process; whereby the respective line material is pushed through a die to create different diameters and strengths is basically the same for both monofilament and fluorocarbon.

Fluorocarbon fishing line is made of the fluoropolymer PVDF and it is valued for its refractive index, which is similar to that of water, making it less visible to fish. Fluorocarbon is also a more dense material, and therefore, is not nearly as buoyant as monofilament. Anglers often utilize fluorocarbon when they need their baits to stay closer to the bottom without the use of heavy sinkers.

Fluorocarbon also contains more material than mono, is non-porous, and has a harder finish. It's virtually a solid material that's denser than water. That means it sinks and doesn't absorb water, the latter quality enabling it to maintain its rated breaking strength whether wet or dry. Furthermore, it has a diameter that's comparable to or smaller than monofilament of the same strength, and also has very little stretch. Both features enhance fluorocarbon's sensitivity and hook-setting ability. Lastly, fluorocarbon is very abrasion-resistant and is less susceptible to damage from the sun and chemicals. The example of fluorocarbon is shown in Figure 2.8.

Figure 2.8: Fluorocarbon line

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Although a tensile test is relatively simple and has been around for a very long time, some thought and consideration must be done to ensure that the test will have valid results. The experiments tests were performed in accordance with the Malaysian Standard that based on The International Standard ISO 2062 'Textile – Yarn from packages – Method for determination of breaking load and elongation at the breaking load of single strands – (CRL, CRE and CRT testers)'. The method authorizes the use of types of testing machines of constant-rate-of-load (CRL) for measuring the breaking load and elongation at the breaking loads of the fishing lines. The appropriate of design of tensile test rig must be choosing to avoid the premature fishing lines specimens' failure and the reference of all the experiments procedures must being made to the testing standard.

3.2 INSTRON UNIVERSAL TESTING MACHINE MODEL 3369

The 3360 Series Dual Column Tabletop Testing Systems as shown in Figure 3.1 are ideal for tension and/or compression applications where tests are less than 50 kN (11,250 lbf). The 3360 Series Dual Column testing systems provide simplicity, performance, and affordability for quality control and product testing. Models are available in load force capacities of 5, 10, 30, and 50 kN. The features of this universal testing machine are as follow:

- 100:1 force range (i.e. use the load cell to 1.0% of capacity with no loss of accuracy

- Load accuracy of 0.5% of indicated load
- 100 Hz data acquisition rate
- Full software control (cyclic capability optional)
- 50 kN (11,250 lbf) capacity
- Maximum speed 500 mm/min (20 in/min)

Figure 3.1: Instron Universal Testing Machine Model 3369

Location: UMP Material Laboratory

3.3 TENSILE TEST RIG DESIGN

3.3.1 Propose Tensile Test Rig

There are two propose design of tensile test rig that are appropriate for single strand fibers that are O-Ring Fiber Clamping Grips and Cord and Yarn Style Grips.

i) O-Ring Fiber Clamping Grips

This rig as shown in Figure 3.2 is designed to hold very small diameter fiber specimens during tension testing. The rubber V-groove provides a gradually increased frictional hold on the specimen and helps reduce grip face pinching and subsequent specimen jaw breaks. Special considerations are built into the design, where the U-shaped bend provides sufficient area for specimen loading.

Figure 3.2: O-Ring Fiber Clamping Grip

Source: http://www.instron.us

ii) Pneumatic cord and yarn grips

This rig as shown in Figure 3.3 provide a convenient method for clamping fiber, cord, yarns and fine wires to reduce the problem associated with testing these materials. A specially designed horn with a smooth finish and a contoured surface with a graduated cam allow for easy loading and a stress reduced clamping area on the specimen. The clamping mechanism can be activated either automatically or through a foot switch. This allows hands-free grip operation enabling the specimen to be held with both hands, for easy loading. Pneumatic cord and yarn grips provide selectable clamping force to accommodate different materials and excellent follow-up action which compensates for decay of the holding force due to specimen creep.

Figure 3.3: Pneumatic Cord & Yarn Grip

Source: http://www.instron.us

3.3.2 Suggestion Tensile Test Rig Design

Face and grip selection is a very important factor. By not choosing the correct set up, the specimen may slip or even break inside the gripped area ("jaw break"). This would lead to invalid results. The faces should cover the entire tab or area to be gripped. It is important to select grips that will allow us to easily install and remove specimens.

Thus, the O-Ring Fiber Clamping Grips as shown in Figure 3.2 have been choosing as tensile test rig for this experiment. This is because; compare to Pneumatic Cord & Yarn Grip, this rig is easy and need lower cost to fabricate. Besides, it easier to handle and set up with the universal testing machine compare to the other grip. The principles of operation of this rig are as follow:

i. The o-ring clamping mechanism uses a self-tightening approach by wedging the specimen between two rubber rings.

ii. Two threaded knurled wheels; each housing an o-ring can be tightened against each other to further adjust firmness at the groove location.

iii. It is not necessary to tighten the knurled wheels for each specimen. Once the appropriate firmness is set, specimens are simply placed into the groove.

iv. A harder specimen may need more firmness in order to lock on the griping area, where a softer fiber may require less firmness to slide into the groove area.

v. The grip body is shaped so that the center line of the loading force passes exactly through the center line of the fiber when the fiber is correctly loaded.

3.3.3 Design of O-Ring Fiber Clamping Grips

Solidwork Software is used to make this solid design of O-Ring Fiber Clamping Grips. There are three parts of components in one rig. The components are Clevis Interface, U-Shaped Bend and Knurled Wheel as shown in Figure 3.4.

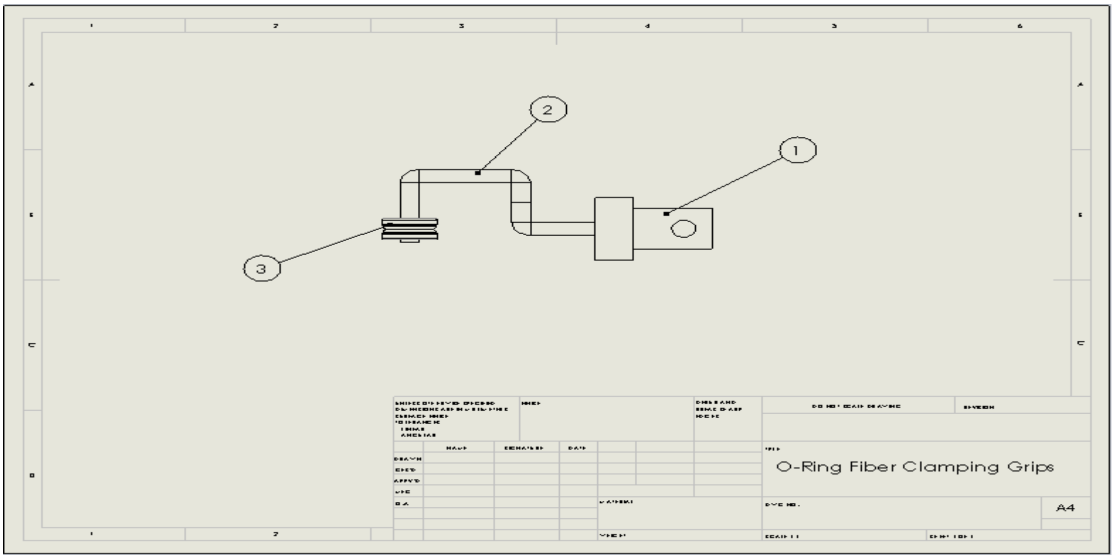

Figure 3.4: Engineering drawing of O-Ring Fiber Clamping Grips

The first part is Clevis Interface. The dimensions of this component need to design properly to allow this rig fit with the upper and lower fit of Instron Universal Testing Machine Model 3369 (see Figure 3.1). Clevis Interface part is shown in Appendix D2.

The second part is U-Shaped Bend. Special considerations are built into the design, where the U-shaped bend provides sufficient area for specimen loading. This part is shown in Appendix D3.

The last part is Knurled Wheel. The rubber V-groove provides a gradually increased frictional hold on the specimen and helps reduce grip face pinching and subsequent specimen jaw breaks. The o-ring clamping mechanism uses a self-tightening approach by wedging the specimen between two rubber rings. Two threaded knurled wheels; each housing an o-ring can be tightened against each other to further adjust firmness at the groove location. Knurled Wheel part is shown in Appendix D4.

Lastly, the three part need to be assembling to make the complete of tensile test rig as shown in Appendix D1. Then, a pair of O-Ring Fiber Clamping Grips as shown in Figure 3.5 is ready to use for fishing lines tensile test.

Figure 3.5: O-Ring fiber clamping grips

3.4 RESEARCH DESIGN

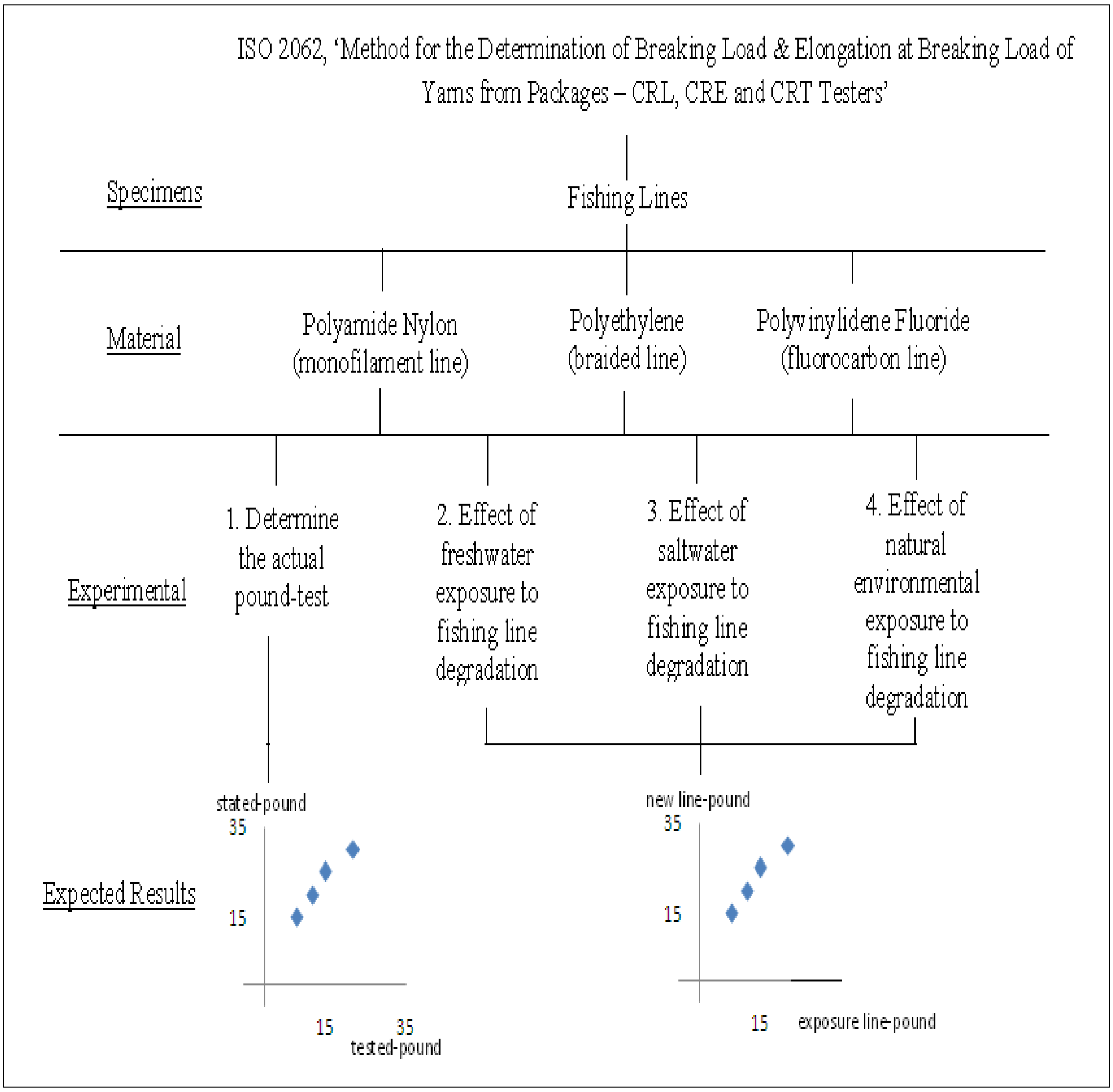

Figure 3.6: Research design

3.5 EXPERIMENTS PROCEDURES

The clamps as shown in Figure 3.7 are properly aligned and parallel are need to be observed so that the subsequent application of force to the specimen will not cause any angular deflection of either clamp.

The specimen was mounting in the testing machine so that the axis of the specimen is at right angles to the edges of the clamps and the specimen is placing under the prescribed pre-tension. The part of specimen that is the length between the clamps which will subsequently be stressed was not to be touch with the bare hand.

The specimen parameter and crosshead speed was set under the specified condition. The crosshead speed was set as 6 in/min and the high extension as 2 in to set the moving clamp in motion at a rate estimated to result in an average time-to break of 20 ± 3 s.

After the specimen has broken, the maximum load is note. The moving clamp was return to its zero position and the ends of the broken specimen were removing. Five of required number of observations on individual specimens was make under essentially the same condition and the average of maximum load was calculated.

Figure 3.7: Alignment of the clamps

CHAPTER 4

RESULT AND DISCUSSION

4.1 SAMPLE OF RESULT CALCULATION

The average breaking load was calculated as shown in Eq. 4.1.

Average breaking load

$$= \frac{\text{sum of observed values for breaking loads}}{\text{number of observations}} \quad (4.1)$$

$$= \frac{11.479 + 12.269 + 11.958 + 10.898 + 11.878}{5}$$

$$= 11.696 \text{ lbf}$$

The percentage of error was calculated as shown in Eq. 4.2.

Percentage of error

$$= \frac{\text{stated pound} - \text{tested pound x } 100}{\text{tested pound}} \quad (4.2)$$

$$= \frac{15 - 9.7 \ \times 100}{9.7}$$

$$= 54.6 \ \%$$

The percentage of degradation was calculated as Eq. 4.3.

Percentage of degradation

$$= \frac{\text{new lines of ave. breaking load} - \text{exposure lines of ave. breaking load x 100}}{\text{exposure lines of ave. breaking load}} \quad (4.3)$$

$$= \frac{5.2 - 3.89 \times 100}{3.89}$$

$$= 33.6\ \%$$

4.2 RESULT AND DISCUSSIONS

4.2.1 Experiment 1: The Average Breaking Load of Fishing Lines

The average breaking load for each specimen that was being tested in experiment 1 is calculated using the equation as shown in Eq. 4.1. A chart of stated-pound versus tested-pound are built to show the differences of average breaking load between the stated-pound lines and the tested-pound lines as shown in Figure 4.1.

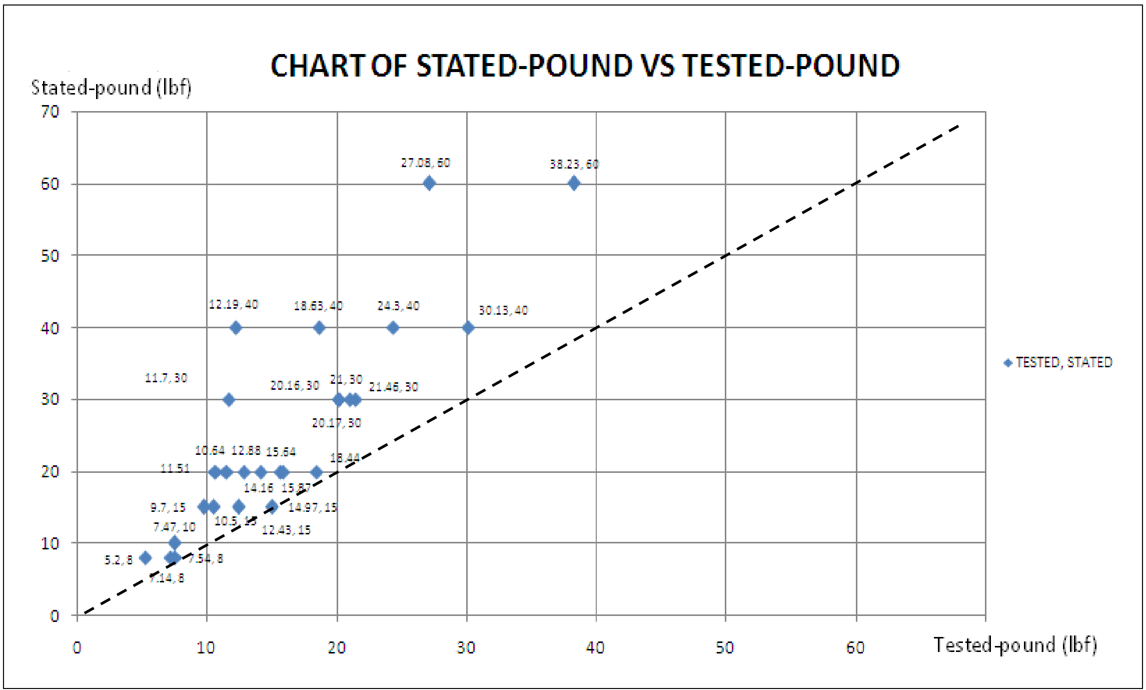

Figure 4.1: The differences of average breaking load between state line-pound and tested line-pound

Then, the percentage of error between stated-pound lines and tested-pound lines are calculated using the equation as shown in Eq. 4.2. The average breaking load and percentage of error between state line-pound and tested line-pound for all fishing lines specimens that were being tested in experiment 1 are compiled as shown in Table 4.1, Table 4.2 and Table 4.3.

Table 4.1: The average breaking load and percentage of error between state line-pound and tested line-pound of monofilament lines

Brand Name	Stated-Pound (lbf)	Tested-Pound (lbf)	Error (%)
Fisherman	15	9.7	54.6
Exory	20	11.51	73.7
I-Fish	20	10.64	87.9
Seahawk	30	11.7	157.5
Conato	30	21.46	39.8
Abu Garcia	60	27.08	121.5
Tomman	40	24.3	64.6
Nelayan	60	38.23	56.9
Berkley Trilene	15	14.97	0.17
Berkley Big Game	20	18.44	8.5
Daiwa	8	5.2	53.8
Triple Fish	10	7.47	33.9
P-Line	15	10.5	42.9
Seaguar	20	14.16	41.2
Stren	30	20.17	48.7

Table 4.2: The average breaking load and percentage of error between state line-pound and tested line-pound of braided lines

Brand Name	Stated-Pound (lbf)	Tested-Pound (lbf)	Error (%)
Otoro	40	12.19	228.1
Besd Internasional	40	18.63	114.7
P-Line Spectrex	30	20.16	48.8
Cortland	30	21	42.9
Stren Sonic	20	15.64	27.9
Power Pro Spectra	40	30.13	32.8

Table 4.3: The average breaking load and percentage of error between state line-pound and tested line-pound of fluorocarbon lines

Brand Name	Stated-Pound (lbf)	Tested-Pound (lbf)	Error (%)
Ajiking	20	12.88	55.3
Seaguar InvizX	8	7.14	12
Stren	8	7.54	6.1
P-Line	15	12.43	20.7
Ohero	20	15.87	26

Based on the result in Figure 4.1 and Table 4.1 until Table 4.3, it shows that many data are distributed on above of dotted line. This experiments result show that there are slightly and high differences between the stated-pound lines and the actual tested-pound lines of various types and brand names of the specimens.

4.2.2 Experiment 2: Investigate the Influence of Fishing Line to Freshwater Exposure

The average breaking load for each specimen that was being tested in experiment 2 is calculated using the equation as shown in Eq. 4.1.

A chart of new line-pound versus wet line-pound are built to show the differences of average breaking load between the new line and the line that subjected to freshwater as shown in Figure 4.2.

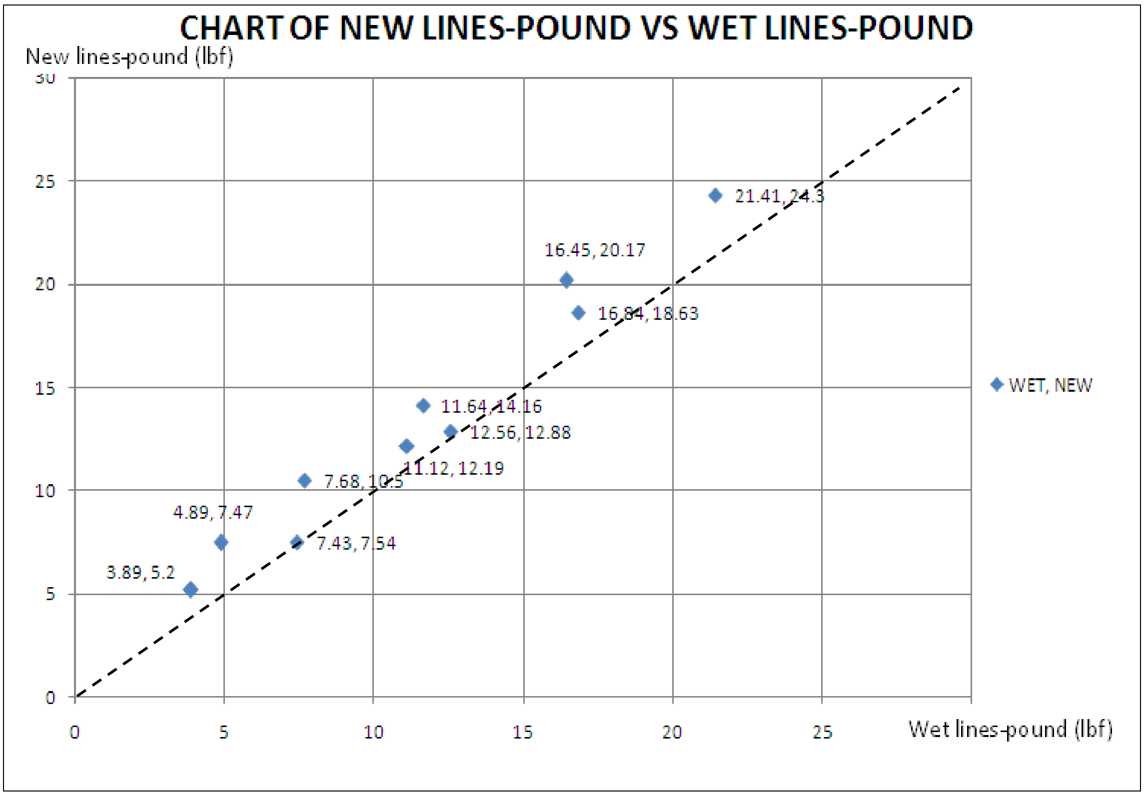

Figure 4.2: The differences of breaking load between new line and wet line

Then, the percentage of degradation between new lines and wet lines are calculated using the equation as shown in Eq. 4.3.

The average breaking load and percentage of degradation between new line and wet line for all fishing lines specimens that were being tested in experiment 2 are compiled as shown in Table 4.4, Table 4.5 and Table 4.6.

Table 4.4: The average breaking load and percentage of degradation between new line and wet line of monofilament line

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Daiwa	5.2	3.89	33.6
Triple Fish	7.47	4.89	52.8
P-Line	10.5	7.68	36.7
Seaguar	14.16	11.64	21.6
Stren	20.17	16.45	22.6

Tomman	24.3	21.41	13.5

Table 4.5: The average breaking load and percentage of degradation between new line and wet line of braided lines

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Otoro	12.19	11.12	9.6
Besd Internasional	18.63	16.84	10.6

Table 4.6: The average breaking load and percentage of degradation between new line and wet line of fluorocarbon lines

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Ajiking	12.88	12.56	2.5
Stren	7.54	7.43	1.5

Based on the result in Figure 4.2 and Table 4.4 until Table 4.6, it shows that many data are distributed on above of dotted line. This experiments result show that there are slightly differences of breaking load between new line test-pound and the lines from several of types and brand names of the specimens that were subjected to the freshwater exposure in 14 days.

4.2.3 Experiment 3: Investigate the Influence of Fishing Line to Saltwater Exposure

The average breaking load for each specimen that was being tested in experiment 3 is calculated using the equation as shown in Eq. 4.1.

A chart of new line-pound versus wet line-pound are built to show the differences of average breaking load between the new line and the line that subjected to salt water as shown in Figure 4.3.

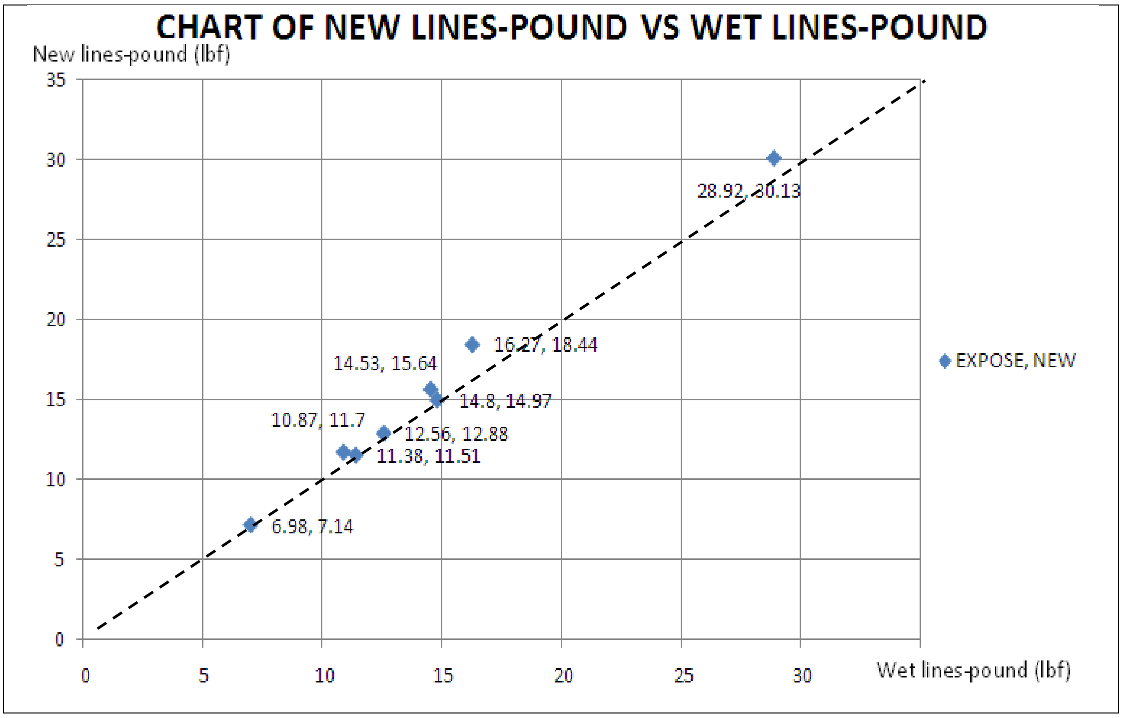

Figure 4.3: The differences of breaking load between new lines and wet lines

Then, the percentage of degradation between new lines and wet lines are calculated using the equation as shown in Eq. 4.3.

The average breaking load and percentage of degradation between new line and wet line for all fishing lines specimens that were being tested in experiment 3 are compiled as shown in Table 4.7, Table 4.8 and Table 4.9.

Table 4.7: The average of breaking load and percentage of degradation between new lines and wet lines of monofilament lines

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Berkley Trilene	14.97	14.8	1.18
Berkley Big Game	18.44	16.27	13.33
Exory	11.51	11.38	1.18
Seahawk	11.7	10.87	7.56

Table 4.8: The average of breaking load and percentage of degradation between new lines and wet lines of braided lines

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Stren Sonic	15.64	14.53	7.6
Power Pro Spectra	30.13	28.92	4.2

Table 4.9: The average of breaking load and percentage of degradation between new lines and wet lines of fluorocarbon lines

Brand Name	New Line-Pound (lbf)	Wet Line-Pound (lbf)	Degradation (%)
Ajiking	12.88	12.56	2.5
Seaguar InvizX	7.14	6.98	2.3

Based on the result in Figure 4.3 and Table 4.7 until Table 4.9, it shows that many data are distributed on above of dotted line. This experiments result show that there are slightly differences of breaking load between new line test-pound and the lines from several of types and brand names that were subjected to the salt water exposure in 14 days.

4.2.4 Experiment 4: Investigate the Influence of Fishing Line to the Natural Environmental Exposure

The average breaking load for each specimen that was being tested in experiment 4 is calculated using the equation as shown in Eq. 4.1.

A chart of new line-pound versus exposure line-pound are built to show the differences of average breaking load between the new line and the line that subjected to natural environmental exposure as shown in Figure 4.4.

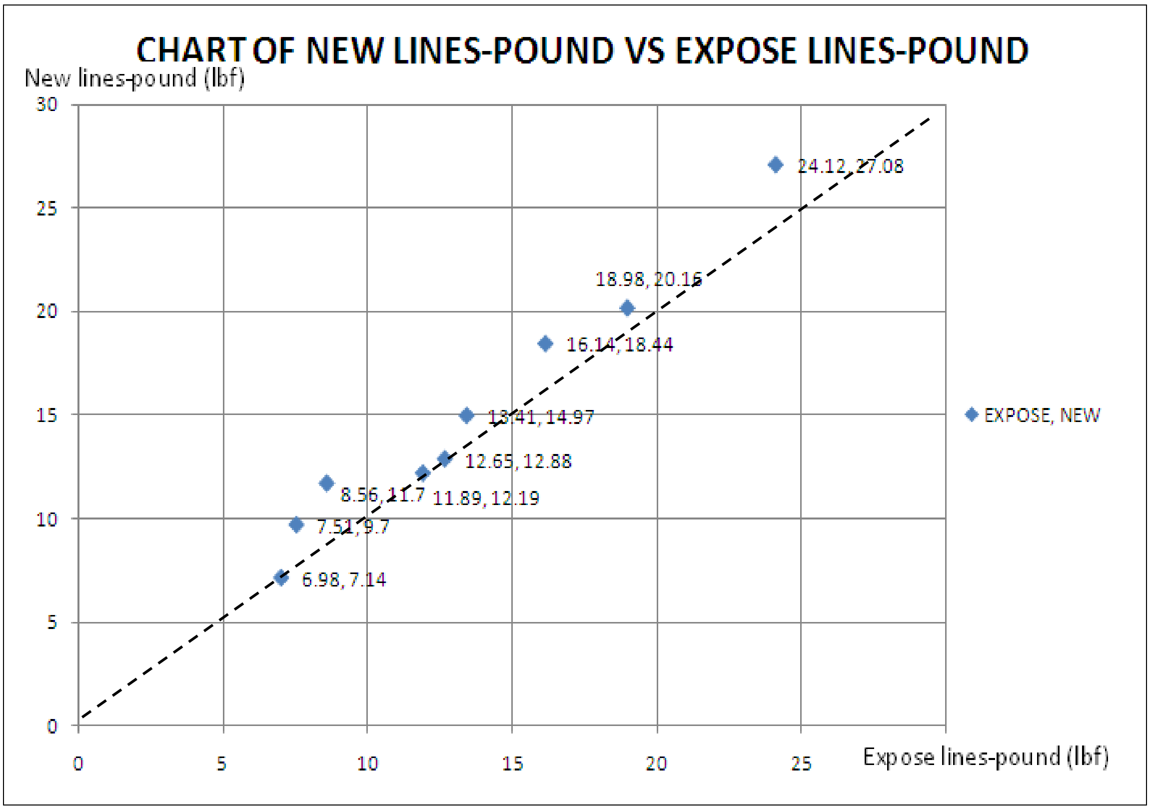

Figure 4.4: The differences of breaking load between new line and exposure line

Then, the percentage of degradation between new lines and exposure lines are calculated using the equation as shown in Eq. 4.3.

The average breaking load and percentage of degradation between new line and exposure line for all fishing lines specimens that were being tested in experiment 4 are compiled as shown in Table 4.10, Table 4.11 and Table 4.12.

Table 4.10: The average breaking load and percentage of degradation between new line and exposure line of monofilament lines

Brand Name	New Line-Pound (lbf)	Exposure Line-Pound (lbf)	Degradation (%)
Berkley Trilene	14.97	13.41	11.7
Berkley Big Game	18.44	16.14	14.1
Fisherman	9.7	7.51	29.2
Seahawk	11.7	8.56	36.7
Abu Garcia	27.08	24.12	12.3

Table 4.11: The average breaking load and percentage of degradation between new line and exposure line of braided lines

Brand Name	New Line-Pound (lbf)	Exposure Line-Pound (lbf)	Degradation (%)
Otoro	12.19	11.89	2.55
P-Line Spectrex	20.16	18.98	6.2

Table 4.12: The average breaking load and percentage of degradation between new line and exposure line of fluorocarbon lines

Brand Name	New Line-Pound (lbf)	Exposure Line-Pound (lbf)	Degradation (%)
Ajiking	12.88	12.65	1.8
Seaguar InvizX	7.14	6.98	2.3

Based on the result in Figure 4.4 and Table 4.10 until Table 4.12, it shows that many data are distributed on above of dotted line. This experiments result show that there are slightly differences of breaking load between new line test-pound and the lines from several of types and brand names that were subjected to natural environmental exposure in 14 days.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Based on the result from the experiments, it shows that there are error between the stated pound-test and the actual pound-test. The error was between 0.17 until 157.5 percent. It means, there are evident that the actual pound-test of varies of type and brand name of commercial fishing lines in the market nowadays is actually lower than the stated pound-test. Besides, it is found that the specimens that were exposed to freshwater, saltwater and the natural environmental give effect to the degradation of strength of fishing line. The degradation has been calculated between 1.5 until 52.7 percent. It means that water and uv light are the factors that cause the strength of fishing lines become lower. That is the reason why fishing line that has been used can not stand for prolonged of time.

5.2 RECOMMENDATION

The recommendation for future study is broad the scope of project by used the other types of polymer fiber such as polyester, elastomers, polyurethane fibers and others. Besides, the other experiment can be continue for investigation the effect of water to the specimens in different of time to get the pattern of fishing lines degradation. Next, experiment of the effect of other mechanism to the fishing line strength can be investigated as an example, exposing the fishing line specimens to chemical acid.

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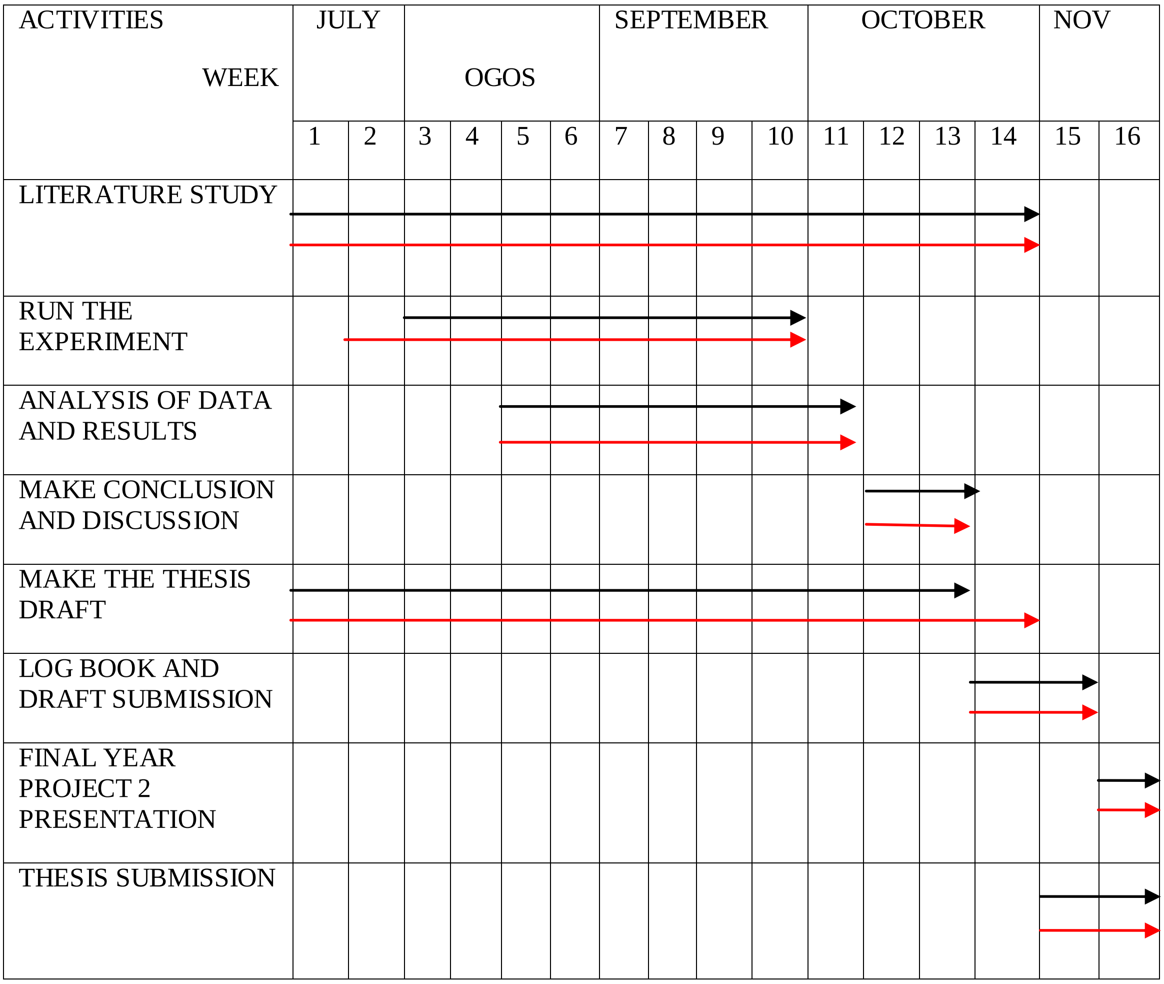
APPENDIX A

Gantt Chart For Final Year Project 1

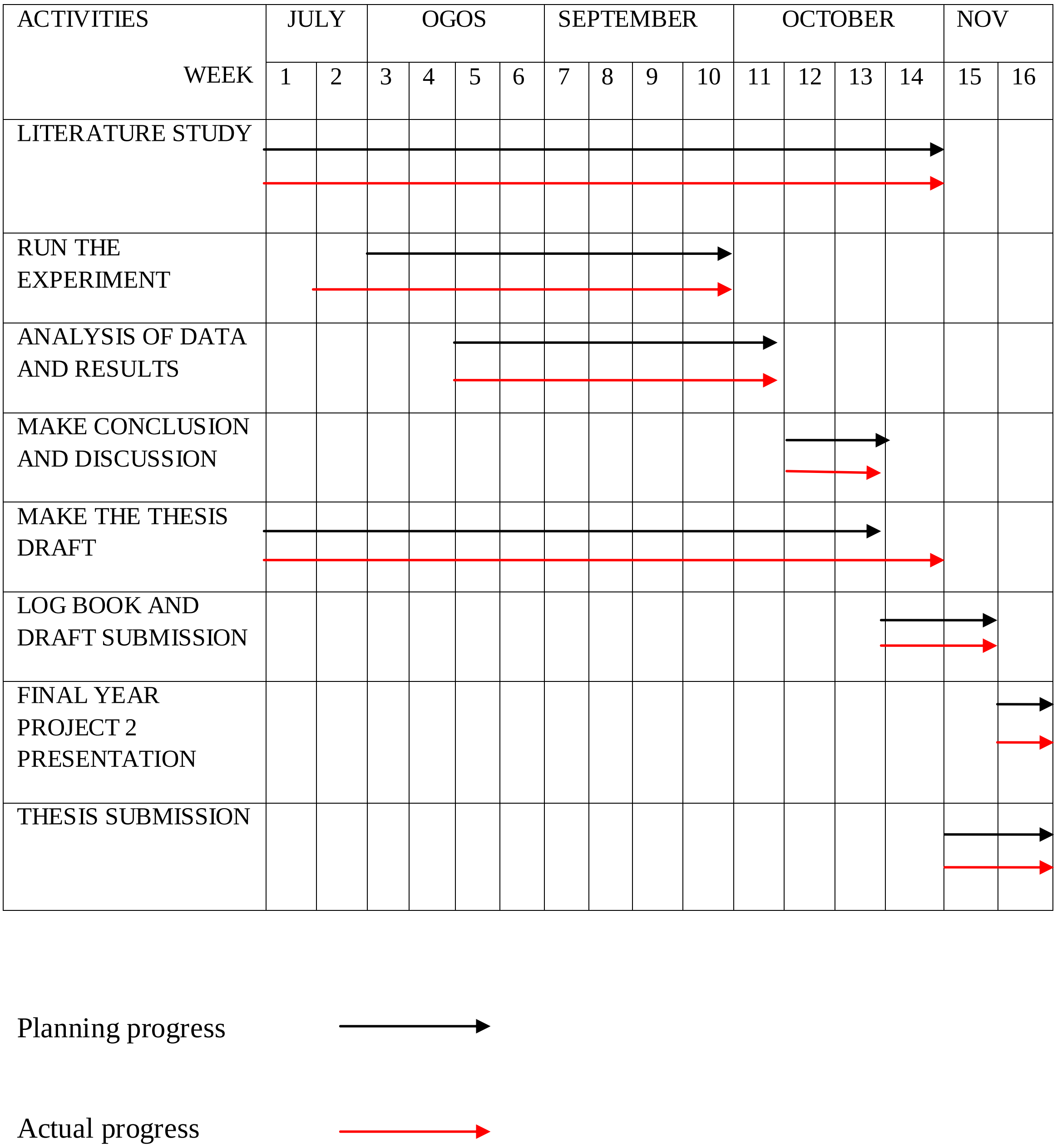


Planning progress →

Actual progress →

APPENDIX B

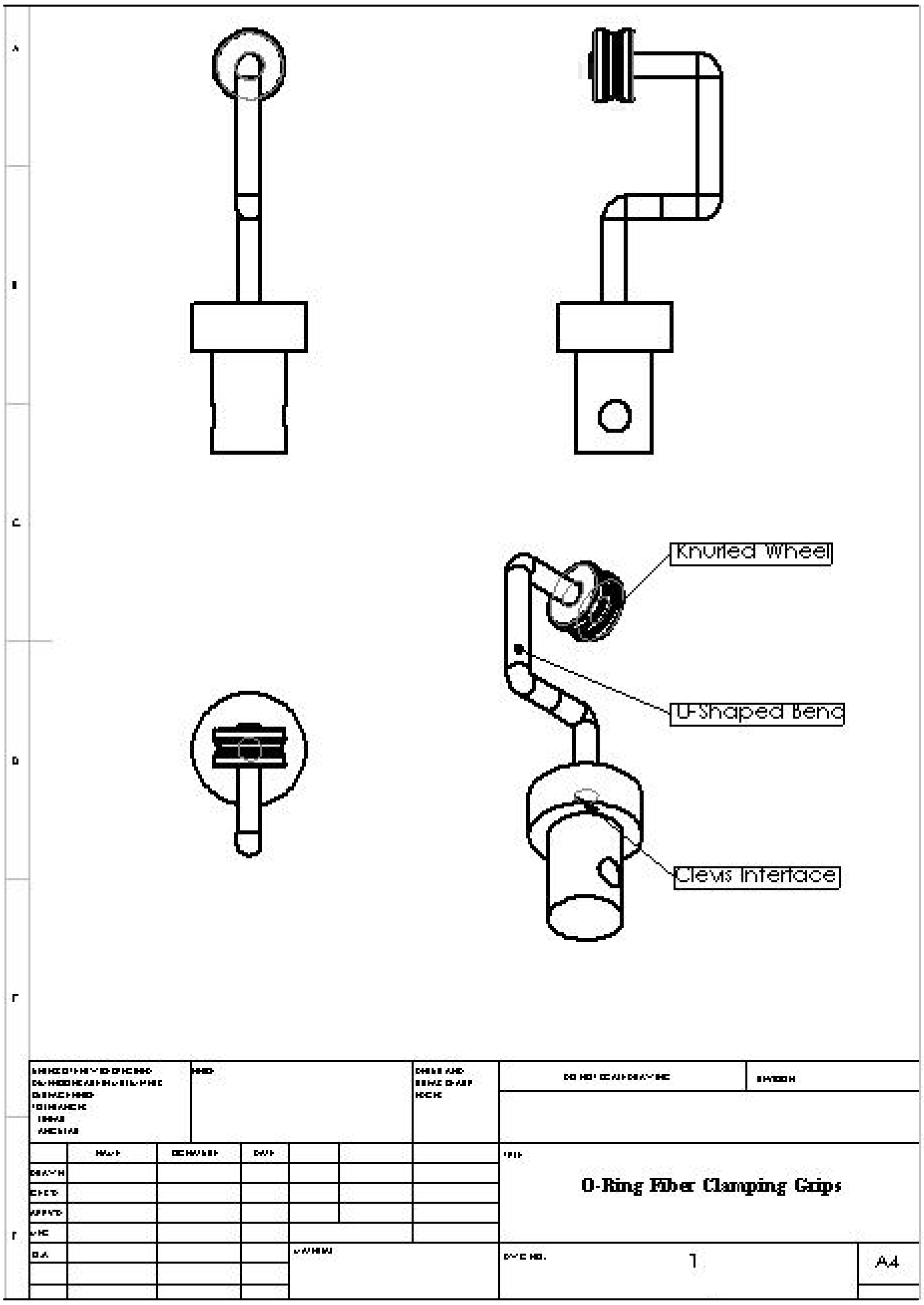
Gantt Chart For Final Year Project 2



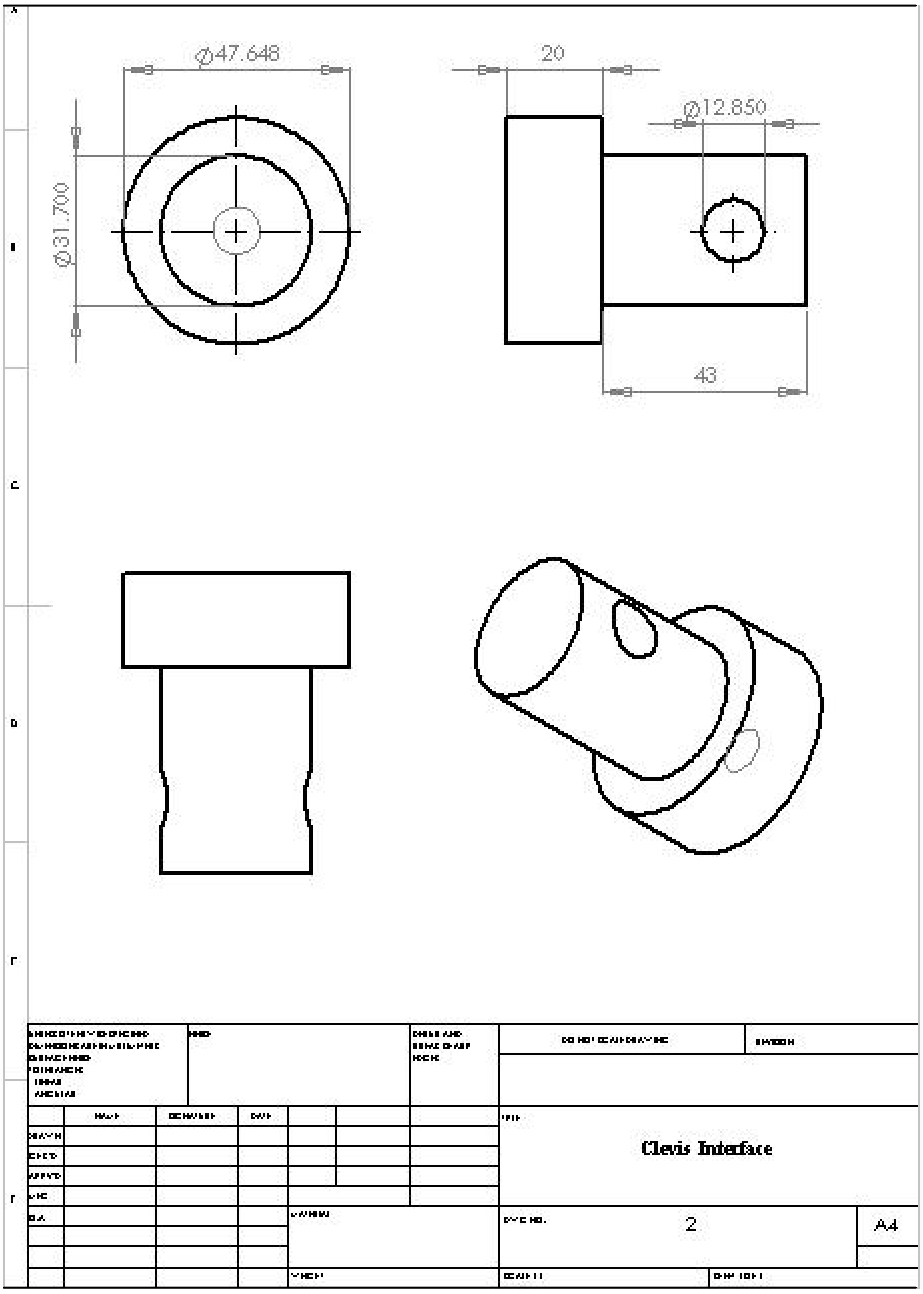
APPENDIX C

Engineering Drawing

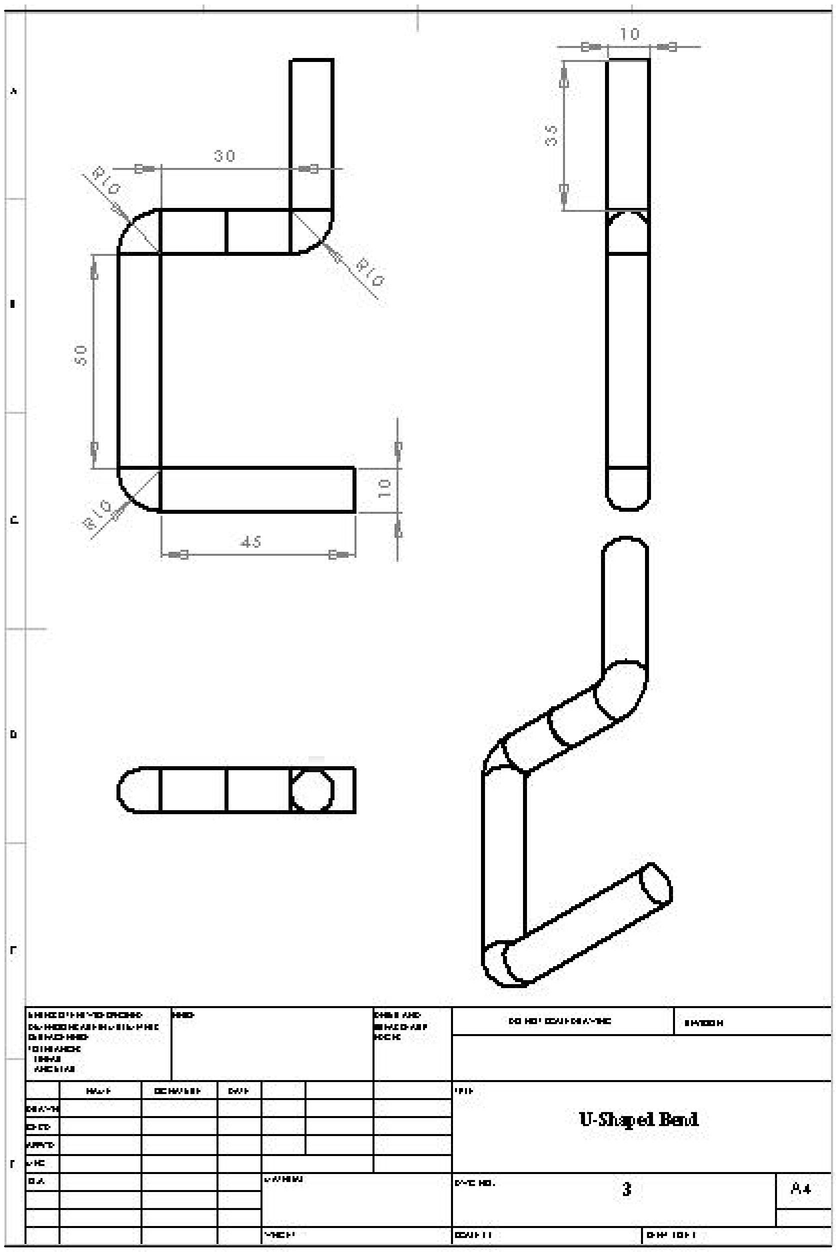
C1 O-Ring Fiber Clamping Grips



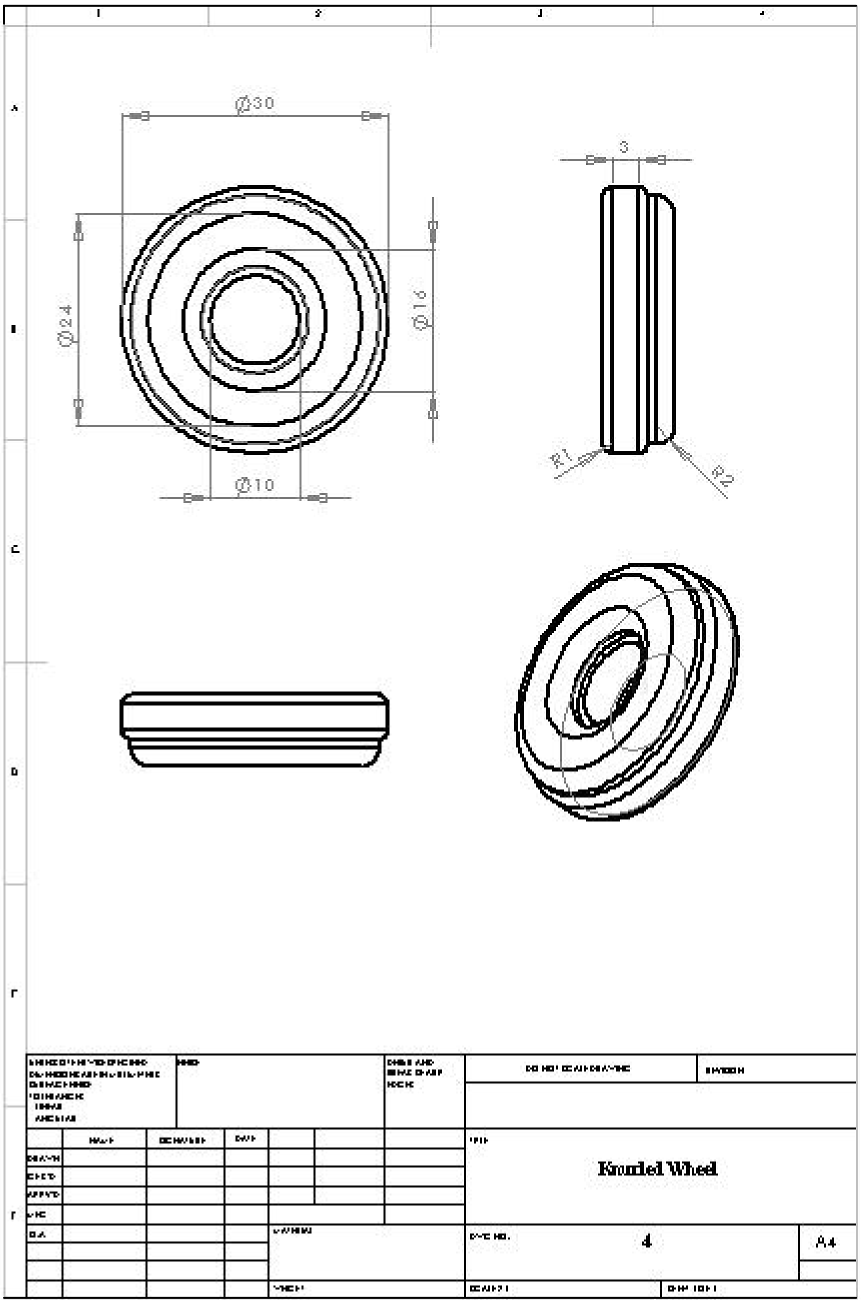
C2 Clevis Interface Part



C3 U-Shaped Bend Part



C4 Knurled Wheel Part



APPENDIX D

Fabrication of Tensile Test Rig

D1 Lathe Machine

Figure 6.1: Lathe machine tools

Figure 6.2: CY lathe machine

Location: KTH Precision Engineering Workshop,
Alor Star, Kedah

D2 Milling Machine

Figure 6.3: Milling machine tools

Figure 6.4: Pinnacle milling machine

Location: KTH Precision Engineering Workshop,
Alor Star, Kedah

D3 O-Ring Fiber Clamping Grips

Figure 6.5: Clevis Interface Part

Figure 6.6: U-Shaped Bend Part

Figure 6.7: Knurled Wheel Part

Figure 6.8: Pair of tensile test rigs

D4 Invoice / Cash Bill

模 型 機 械 工 程

KTH PRECISION ENGINEERING (AS 0268438-M)

78-A, Taman Mahawangsa, Seberang Jalan Putra,
05150 Alor Setar, Kedah Darul Aman.
Tel: 04-7316887 H/P: 012-4731687 Fax: 04-7306887
Email: kth_precision@yahoo.com

INVOICE / CASH BILL

TO: CASH

ATTN.:

Invoice No : KTH 02140
Date : 16. 9.2010
Your Ref No :
Delivery No :

ITEM	DESCRIPTION	QTY	U. PRICE	AMOUNT
1	to Fabricate and supplied material for jig	1 unit		170 -
		SUB-TOTAL		170 -
		LESS DEPOSIT		
		TOTAL RM		

No complaint will be considered unless notified within 7 days of this invoice date.
All cheques should be crossed A/C payee only.

RECEIVED BY

CHOP & SIGNATURE

KTH PRECISION ENGINEERING

APPENDIX E

Steps of the Experiments Procedures

Figure 6.9: Knot of 'Surgeon's End Loop'

Figure 6.10: Assembling of tensile test rig and universal testing machine

Figure 6.11: 'IX series' icon on computer

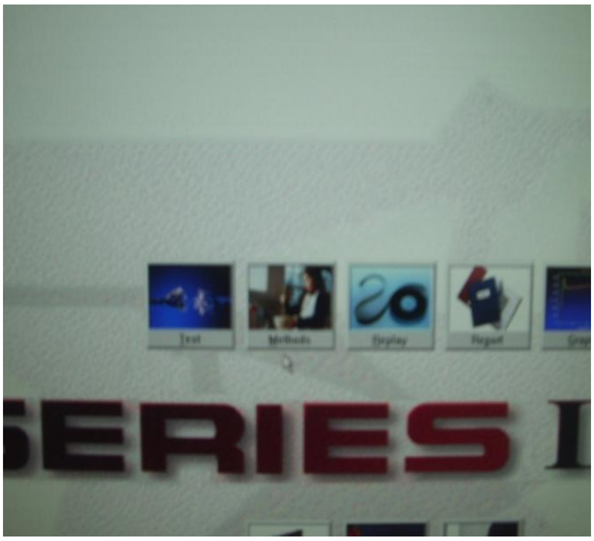


Figure 6.12: 'Method' icon

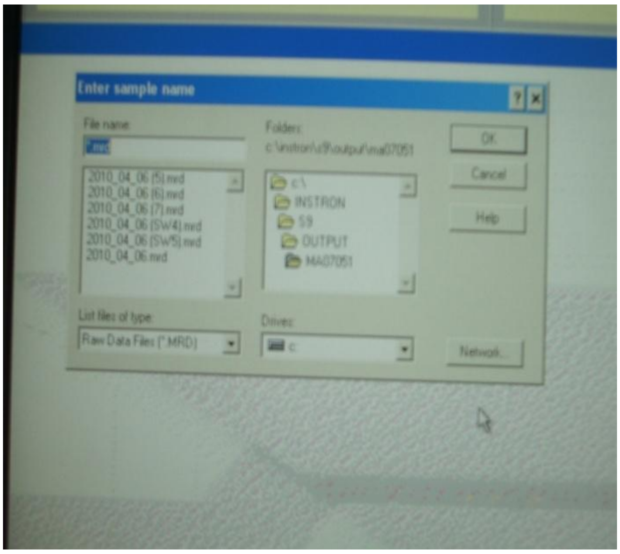


Figure 6.13: Sample file and operator's name

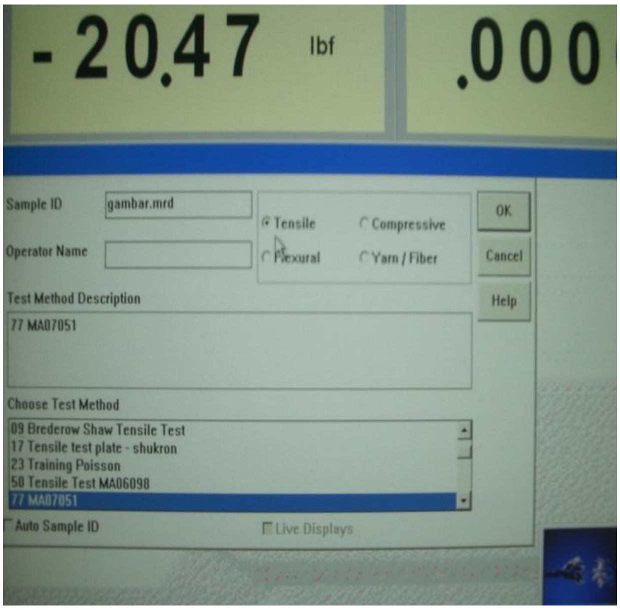


Figure 6.14: Tensile test method

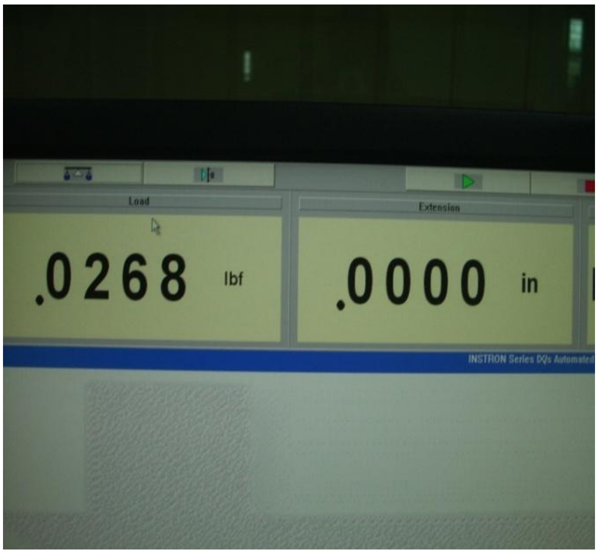


Figure 6.15: The load and strain icon

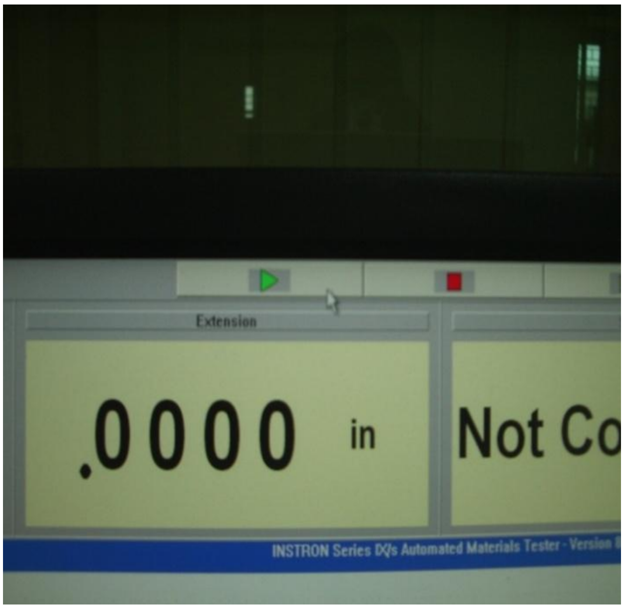


Figure 6.16: Start button

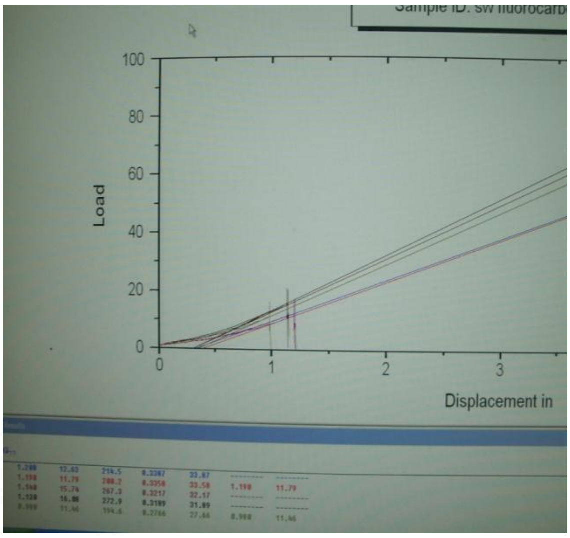


Figure 6.17: The result of experiment

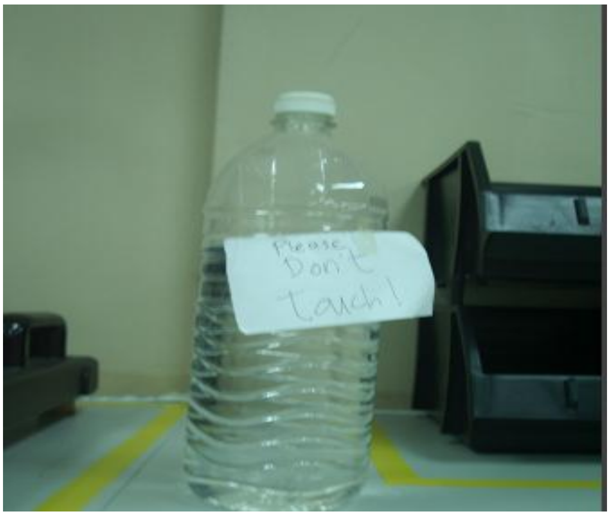


Figure 6.18: Fishing lines that expose to freshwater and saltwater for 14 days

Figure 6.19: Fishing lines that expose to the natural environmental exposure for 14 days

APPENDIX F

Sample of the Experiment Data

Table 6.1: Sample of the experiment data

Observation / Type & Brand Name of Specimen	1 (lbf)	2 (lbf)	3 (lbf)	4 (lbf)	5 (lbf)	Average Breaking Load (lbf)
Nylon line, Seahawk	11.479	12.269	11.958	10.898	11.878	11.696
Nylon line, Abu Garcia	24.496	26.033	28.264	26.846	29.781	27.084
Nylon line, Big Game Berkley	18.689	17.674	17.851	19.980	18.013	18.441
Nylon line, Exory	11.406	12.030	11.306	12.294	10.525	11.512
Nylon line, Tomman	23.987	23.123	23.725	26.126	24.554	24.303
Nylon line, Conato	21.177	21.516	21.690	21.601	21.303	21.457
Braided line, Besd International	17.782	20.845	18.943	16.258	19.317	18.629
Braided line, Otoro	12.171	12.603	11.534	12.760	11.899	12.193