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INTRODUCTION:

The present M.Phil disseration was undertaken to investigate. "The physical fitness of factory workers belonging to various age groups". The Department of Zoology, Shivaji University, Kolhapur is going to submit a big project entitled "Studies on occupational work load and physical fitness status of textile workers in South-Western Maharashtra" to the University Grant Commission (U.G.C.), New Delhi. The present disseration is being the preliminary part of the above project.

Despite the rapid mechanization, mannual work is still predominant in many industries in our country. The workload on the workers engaged in certain task often exceeds to optimum limit for continuous work. The evaluation of the degree of physical efforts involved in these tasks and identification of the possible reason for under physiological strain and consequently fatigue in workers required through scintific investigation.

Physiology of work may be defined as, that branch of knowledge which concerns itself with man as a working being; it exists both as a pure science, as a branch of human biology and as an applied science. It's objective in the later role, being through the application of physiological research methods to obtain useful information about physical working condition in industrial occuption and to study the means of improving these

conditions in order to lighten the workers task while improving his capacity. The Physiology of man, especially with reference to 'man as a working machine' has long tradition in several countries, including U.S.A., Germany, U.K., Scandinavion countries. A basic knowledge of physiology of work can be contributed to a more objective evaluation of work. If physical working conditions are improved the same or improved production rate may be attained with less strain on the workers, to the obvious benefit of both labourer and management. From the physiologists point of view, such studies are concerned with the load or stress to which a certain type of productive activity, places on the individual worker rather than with the productivity of a given group of workers. The heavy and physically strong European worker and his smaller and less strong Indian counter-part eg., many under identical condition achieve the same production but physiological load or strain involved may differ significantly. The former may have a wide margin of safety due to his larger size and sturdier physique, better nutrition state and more systemic training etc., while the later may be working close to limit of his capacity.

The job evaluation should as far as possible be objective and quantitative, subjective qualification such as strainuous, fatiguing etc. should be if possible omitted. Reason is that the concept such as efforts and strain are the fatiguing effects of certain job refer only to primary demands of the job

but also the capabilities of workers.

If a careful and quantitative evaluation of the different jobs has been done, it should be at least theoretically to select workers who are fit for these jobs and to exclude those are unfit. The ideal results of such a preselection would be fairly uniform group of workers doing the same job, so that, the satistical term "Average worker" as applied by work study specialist would have low spread. Also termed as 'reasonable work load' and 'reasonable efforts', rest allowances and fatigue would then mean the same thing for the work study engineer, the physiologist and industrial physicians. A careful and meaningful preselection procedure would undoubtedly narrow the present gap between these two approaches; one of which is concerned mainly with average figure while the other is concerned with health and well being of the individual workers.

Fitness is an ambiguous concept and must be spelled out in specific term in each individual case. If our main concern, is to select worker for jobs where energy expenditure is relatively high and if they have to perform heavy or extremely heavy work then we have reasonably simple and fairly exact methods at our disposal. It should, however, be emphasized that, physical fitness is not a static condition; it not only varies with body dimensions and age, but also depends on the general health and nutritional status of the worker. If a worker is physically inactive, for sometime due to illness or

other reasons, he may loose his fitness. It should further be mentioned that, a worker doing light work may adjust himself to low level of physical fitness. Any change from a light to heavy job may necessitate a period of training or intense extra strain on Worker.

A. REVIEW OF LITERATURE:

'Health is wealth', we know this form ancient times, Poor health leads to unfit physique. Thus, there is a relation between the health and the physical fitness. Physical fitness is related with working capacity or work efficiency. Although number of the factors are responsible for one's working capacity.

Tucker and Cole (1986), observed that, a physical fitness works as a buffer against stress, which is a significant agent in the pathogenesis of physical and psychological illness. Rahe and Lind (1971), and Theorell and Rahe (1971) reported that, stress is a risk factor of cardiovascular disorders. This findings later on was confirmed by Haynes and Feinleib (1980), Stress is not only the factor which can affect the physical fitness but the several mental-emotional maladies such as anxiety and depression which equally affect the physical fitness (Vinokur and Selzer 1975, Grant et.al. 1978; and Rahe 1979). Elliott and Eisdorfer (1983), Duff an Fritts (1984), and Rosch (1984) worked on other factors such as absenteesm, accidents, employee's dissatisfaction, alcohol an drug-abuse, decreased job performance and poor interpersonal communication, and any case to conclusion that the

above factors results in poor gross production.

Flokins and Sime (1981); and Lamb, (1984) findout that, a physical fitness is associated with physical and psychological health traits. As fitness increases the body and mind tend to function more effectively and efficiently. Devries and Adams, (1972) reported that, the fitness comes with greater potential muscular relaxation. Ledwidge (1980) observed that, enhanced self esteem and reduced anxiety and depression improved the management of stress emotions and increased physical adaption. Lamb (1984) further observed that, in physically fit persons resting heart rate is lower and stroke volume is greater. Leblance et.al. (1977) still further observed that, in physically fit persons plasma-glucose and insulin levels are lower; whereas, Young and Ismail (1978) reported that, in physically fit persons testosterone level is higher in relation to those for unfit persons. Peronnet et.al. (1981) reported that in physically fit persons there is less increase in norepinephrine level following termination of work. White et.al. (1976) found out that in fit persons the level of cortisol is low after work.

Winder et.al. (1979) reported that, in physically fit person there is less accumulation and faster elimination of lactic-acid from blood stream following the termination of work. In general fitness appears to promote faster recovery following the body's response to stressors (Sinyor et.al., 1983,.

The number of physical factors depend upon the age of the individual. The effects of age on the physical working

capacity studied by Astrand (1952, 1956, 1958), and he reported that, working capacity decreases with increasing age. The physical fitness of an individual not only depends on age but also depends on his nutritional status, body built, health, family problems, exercise habits and work.

The number of research workers worked on different aspects of physical fitness. Shephard (1987) worked on the energy consumption and health reported that, if one needs higher energy consumpton for minimum work, one would not be fit. Clausen (1977) reported that, in response to standard workload, physically fit, relative to unfit person showed less heart rate increase with more rapid return to baseline following termination of work. Pang, W. (1984) reported that, blood pressure and pulse rate are age-related, but cardiac volume is not related with age. Yamaguchi and Miyazawa (1987) reported increased oxygen uptake during work. Monnier, et.al. (1987) observed that, heart rate is a remarkable indicator to know one's physical fitness, whereas Hofman and Walter (1987) reported that, higher the blood pressure lower the physical fitness. Miller et.al. (1986) observed that, excessive work leads to fatigue.

Ong and Sothy (1986) reported that, exercise improves cardorespiratory fitness of an individual; and (Zhu, 1986) as greater the lung-$\dot{V}_{O}$ volume, working capacity is more. Hostetter and Schultz (1982) reported increased energy expenditure in smokers. Aihara and Michiko (1987) studied diet and its

influence on physical fitness but that was only servey of diatory life of workes in Sendai (Japan). Whereas, Hargreaves et.al. (1987) observed that preexercise carbohydrate feeding improves endurance cycling performance. Terzi et.al. (1987) reported that work efficiency of the workers depends on surrounding heat-stress whereas the protective means and clothing enhances the production, ultimately the work efficiency of the workers. (Rohmr) and Wangenheim (1986) reported that right body poture workshift schedules in order to minimise the time needed for readjust to new work schedule, and reported that worktime of worker should be rotated.

While studying all the above parameters scientists faced various problems, including, difficulties to know the physical parameters duringwork, errors in readings due to variety of work-areas, machinery work-types etc. To overcome these obstacles they suggested various methods, Ganguli et.al. (1986) has given a simplified method for determination of blood-lactic acid levels in occupational health practice Mcanena et.al. (1986) used indirect calorimetry to know energy expenditure while McNeill and Rivers, (1987) determined energy expenditure with the help of oxygen consumption meter i.e. Oxylog. Nielson and Petit (1987) reported that, the metabolic rate of an individual can be determined by counting heart-rate. Dales and Anderson (1987) used the 'Lifetest'/Strength test for assessment of dynamic strength of an individual. Patton and Duggan, (1987) used bicycle ergometry and Jones and Wake-field (1987) used 'step

test' to know physical fitness of the workers whereas, Mundal and Rodhal, (1987) assessed physical activity of the workers questionnaire and personal interview with particular reference to fitness.

B. WHAT IS PHYSICAL FITNESS?

'Fit not fat', 'Run for your life', 'Work that body', No one remember any more who coined these and similar catch phrases, but they have become as familar as the old maxim 'an apple a day keeps the doctor away'. In the space of a decade we have witnessed a social revolution fitness has become the new morality. Individuals from all sections of society and from all walks of life have supported the cause and mouthed its dogma.

The physical fitness and well being of man depend on his everyday physical activity. Fitness is an ambiguious term, and must be spelled out in specific terms in each individual case. It is an everchanging state of the individual body and may be affected by diseased conditions, strainuous work, environmental or mental stresses etc. A person may or may not be attaining physical work he must keep himself physically fit. In the broader sense one must be healthy, i.e. physiological systems with properfunctioning promotes the physical fitness, which are mainly respiratory system, circulatory system, excretory system, nervous system and muscular system.

Before knowing the details about the above systems, we first look towards the needs of physical fitness.

1) It lengthens the total life-span of the individual.

2) It decides the health conditions.

3) It helps in enhancing the abilities and capacities of the individual and thus endows the rising production.

4) It also lessens the chances of tiring and fatiguing.

Thus it maintains the man-machine in well lubricated and best conditioned during work. According to Christopher and Hetty Einzig 'fitness is not health. The term fitness as it is used, merely refers to the cardiovascular and respiratory system. To be fit means you have a strong, hard-working heart and lungs. It does not mean that they are free of disease or abnormalities, or that, the rest of your body is likewise immune to sickness.

Real enjoyment of life or work is rooted in the physical fitness. Physical activity enhances the physical fitness. In the modern industries working conditions are characterised by gradual elimination of physical activity resulting in decline of physical fitness. The interelationship between physical activity and health has been studied by many investigators, and it is apparant from their investigations that eliminated physical activity results in musculoskeletal and cardio-pulmonary function deterioration.

A person's physical performance capacity (PPC) is made up of several aerobic power and endurance, maximum aerobic power and capacity , maximum muscular strength and endurance and neuro-muscular co-ordination. Physical activity in a person depends on Basal Metabolic Rate (BMR), which is based upon age, sex and body surface area. Metabolism is the method by which foods are brokendown and converted into energy, and is kept in reserve in the body. By virtue of metabolism cells are provided with capacity to contract, conduct, secrete, absorb, grow and reproduce. Hence, metabolism is the backbone for all physiological phenomena that one can see or measure.

Before knowing the depths we first sight over few important terms -

1. **Energy:**

Energy is usually defined as the capacity to perform work. Six forms of energies are known i.e. mechanical, heat, light, chemical, electrical and nuclear. Each can readily be converted from one in to another from Since, energy can neither be created nor destroyed, the total input in the body must be accounted by total output, which can be expressed as -

Energy input = Energy output

Chemical energy of food = Heat energy + work energy $\pm$ stored energy

Depending upon age, size and sex, the average calorie intake needed for maintaining body weight for most people during

a normal day varies between 1,500-3,000 Kilocalories/day. It increases during work and exercise conditions.

2. Work:

The physicist defines work rigidly as a product of force times the distance through which this force acts i.e. Work = Force X Distance.

The physicist's definition of work is often unsatissfactory and unfair from the standpoint of physiology. For instance, if a man hold 5 Kg. in his hand, while his arm remains motionless in the horizontial position, he is not doing any work, since the distance is zero, yet he quickly gets fatigued. While it is common to express static or isometric work as the product of load and time. There are a number of other different terms by which work may be stated.

3. Power:

The term power is used to represent work in a unit of time. It consists of strength and speed and may be stated as

$$\text{Power} = \frac{\text{Work}}{\text{Time}} \quad \text{or Power} = \frac{\text{Force X Distance}}{\text{Time}}$$

4. Efficiency:

It is written as a percent of total energy used, researches have generally shown two distinct methods for computing it. The first and simplest, is gross efficiency, in which the total energy used is divided into measrable work.

$$\text{Gross efficiency (\%)} = \frac{\text{External work output}}{\text{Total energy used for work}} \times 100$$

The second method is called net efficiency. Since at any given time of the day a certain amount of the energy used up by the body is being used to maintain life (Basal requirements). In order to determine net efficiency of the working body, the basal requirements should be sub tracted from the total energy cost.

$$\text{Thus, Net efficiency (\%)} = \frac{\text{External work output}}{\text{Total energy used for} \quad \text{Basal requirements}} \times 100$$

Performance of large muscles in men usually results in a net defficiency of 20-25%. Individual differences are unavoidable, which inclue body size, fitness, skill and speed of work.

5. Endurance:

It can be defined as the ability to maintain performance or work at a sustained level over a prolonged period of time. The limits of human endurance are being continually extended. Training improves endurance under different conditions effective endurance training can improve the strength of the heart, increase blood volume and haemoglobin content in the body, reduce systolic and diastolic levels of blood pressure, lowers the resting heart rate, help to control cholesterol count, controls weight levels.

6. Maximum Aerobic Power:

It also means maximum oxygen that can be consumed per minute. It can be determined by measuring the maximum oxygen

uptake during dynamic muscular exercise. Peak values of maximum aerobic power are attained in early adulthood. In men, there is a gradual decline from the age 25-30, until at the age of 70, it is about 50% of its value of 20 years. In women, the peak value is reached soon after maturity, remain constant during part of her fertile life and then declines as in men. (Saha, et.al.,1971).

7. Muscle Strength:

Dynamic strength is characterised either by shortening of the muscles during contraction (concentric contraction) or by a lengthening of the muscles by some outside force, such as gravity (eccentric contraction). When force is exerted without movement, the muscles are in a state of static or isometric contraction. Strength in isometric contraction is greater than in concentric contraction but less than in eccentric contraction.

In average body strength of adult women is about 65% of that of men. Maximum muscle strength is at about 30 years of age and from then it goes on decreasing, prolonged periods of inactivity greatly reduce muscle strength, the large muscle groups of trunk and lower extremities being the most susceptible.

The body composition and body size determine the physical fitness. High correlations have been found between maximum aerobic power and lean body mass, total haemoglobin, total body water and the total body potassium. The ratio of lean

body mass to total body weight undergoes changes during growth, development and aging and also showed significant sex differences.

Changes in body composition under training may take place without noticeable changes in body weight lean body mass may, for instance, increase at the expense of fat. When training is discontinued, body weight may increase solely because of the deposition of fat.

Physical fitness and training:

Physical training improves all the elements of physical performance capacity. Training improves oxygen transport system in two ways i.e. regulatory and dimensional changes. Regulatory change showed a change in the cotractibility of myocardium; while dimensional effects of training comprise actual increase in the volume of the lungs, the amount of blood in the body and the heart size. A continued physical activity can only exert the continued physical fitness and the young people, therefore, should be taught the kind of actvities that they can continue after leaving school and encouraged to maintain their bodies physically fit.

Regular and continuous training shows following physiological changes:

1. Reduced heart rate at rest, work.
2. Quicker heart rate recovery following work.
3. Increased stroke volume.
4. Increased cardiac output.

5. Reduced blood-pressure during rest and exercise.
6. Increased blood volume, haemoglobin and red blood cells.
7. Reduced blood flow per kg.of working muscle.
8. Increase in number of capillaries.
9. Increased respiratory effieiency.
10. Increased lung-volume and diffusion capacity.
11. Increased neuromuscular efficiency.
12. Increased haemoglobin concentration.
13. Reduced body fat with an increased muscle mass.
14. Increased skeletal muscle capacity for oxidizing carbohydrates and fats.

Exercise improves physical fitness:

Regular and adequate exercise improves physical fitness. The major benefits of such exercise are described as below:

1. It helps to maintain the cardiovascular system, muscles and joints in good working conditions.

2. The training effects of vigorous aerobic exercise are of greater efficiency of circulation, particularly in the heart, working muscles and oxygen transport.

3. Generally, physical activity increases muscle strength, the strength of joints, their flexibility and mobility, the strength of tendons and muscle attachments. The improved strength of postural muscles.

4. This all contributes to greater physical endurance and less fatigue.

5. Exercise counteracts obesity.

6. Exercise improves a wide-range of physiological functions, e.g. lowering the level of blood-fats, tri-acyl glycerides.

7. Physical activity helps to counteract stress.

8. Exercise improves posture , appearance, self-image.

9. Mild hypertension (high blood pressure) may also be reduced by regular exercise.

10. The general benefits of exercise are particularly important as a preparation for healthy retirement.

Along with the training and exercise, diet is also important factor maintaining the physical fitness. Caloric demands are higher in working people than nonworking people. Appropriate food of sufficient amount plays a key role in physical fitness of an individal. It is necessary to take the adequate amount of food suppot the subsequent activity and proper functioning of the body. Diet should supply essential elements of nutrition i.e. carbohydrates, proteins, fats, minerals and vitamins.

It is difficult to define physical fitness than to recognize unfitness. Fitness is good for all which assures the longevity of life eventhogh it is not an elixir for the life. Leisure time tries the body while fitness not only fresh up the body but also the mind and thus endows a happier and healthy life. To live

with smilling face one must be fit physically. Unfit body becomes invitaton for the diseases, aches and pains; one losses his concentration and regresses the work rate ultimately the production. One could maintain the work pace and skill then and then only when he is physically and mentally fit.

C. REASONS THAT LED TO UNDERTAKE THE PRESENT INVESTIGATION:

Today's industries are the wheels of progress of wise human beings. A hudge data of tools, equipments help him hand in hand and hold him uprise. Production capacities of the modern industries are increasing day by day, and ambitious man is bouncing with joy from the bottom of oceans to the skyhighes. Although, the modern machines are the ladders, brain is must to step up and hands are must to hold up. Manpower is there to follow the machines. Comparing to the European countries, in India manpower percentage in industry is remarkably greater. This is due to dense population, illiteracy, unemployment and less modernization of industries. No doubt Indian economy is the root cause for the application of the hudge number of workers in Industry.

The methods like ergonomics are developed and applied very well by the European countries in their industries but we Indians are far behind; not less than thirty years. Although, modernization of Indstries is done, there are no vacancies outside for the poor wokers; they have to face unemployment. Thus,

employing more workers than the costly imported machineries became the only solution. We have to solve our problems at our own.

If we knock the doors of our industries, we could sight number of things. In our industries workers are handling the large machineries. They are facing hot furnesses, carrying the loads, cutting and finishing the job etc. Bathing in the sweat they do not care their health. Not only the workers but also the management know the workers health standards. Aiming the production, management runs the workers. This can be well illustrated by the Bhopal Gas Tragedy in Union Carbide indicating managements carelessness towards workers security and safety.

Apart from that workers are doing the same job i.e. same type of work throughout their service, on the same machine, on the same place and in the same environment (monotonous work). They must have been subjected to various stresses and strains. To know their health standards, their physical checkups must be done periodically. Their physical fitness is hampered by these stresses and strains which is not recovered by their lowcalorie diet.

Before knowing their physical fitness, first, we must know what are the health hazards they have to face in industry.

Health may be defined as an adjustment of the individual to his physical, mental and social environment rather than the absence of disease. In man's working environment the

interrelationship of three important factors, namely, the worker, the raw material, as well as the processed material the machines and the environment is to be considered.

Health hazards in Industry:

1. Chemicals:

Various chemicals are used during processing or production. They are poisonous or toxic and workers are coming in contract with such chemicals in the absence of sufficient precautions. The chemicals used or produced, hurt to workers in various forms, such as (i) Poisonous gases and vapours eg. SO_2, CO. (ii) Particulates in the form of dusts, fumes, mists and smoke. These chemical contiaminants enter human systems through three avenues = inhalation, absorption through skin and ingestion.

Chemicals showed various harmful effects of poisoning either acute or chronic. Acute poisoning results into irritation of respiratory organs and narcosis, while chronic poisoning including damage to lungs, to blood, nervous system, liver, kidneys, bones, skin etc. A few examples can be cited (i) Inhalation of dust containing free silica will produce silicosis, (ii) Benzene, arsenic and lead will produce blood changes, (iii) continued contact with coaltar and shale oil results in skin cancer, (iv) cutting oils use leads to skin dermatitis. Therefore, chemicals should not be allowed to come in direct contact.

2. Noise:

Prolonged exposure to noise is now recognized as a major

industrial health hazard. In Britain, the recommended legal limit for noise is 90 dBAs. Above that protective equipments must be provided, including earplugs of elastic, rubber or glass; earmuffs and helmets are also good means of protection.

3. Machinery:

Accidents resulting from faulty, or improperly used machinery are a continuing problem. Safety laws are specific on guarding moving parts and inspecting unguarded machinery. Guards should provide positive portection without discomfort to the workers and prevent all access to danger areas during work.

4. Hand-tools:

More than 10,000 accidents in factories every year are caused by common hand-tools (UK), use only the right tool for the job. Where there is a risk of an explosive atmosphere, use non-sparking tool, use tools which are in good conditions, store all the tools safely, particularly at heights, Wear eye-goggels when provided.

5. Lifting:

Most spinal injuries result from incorrect lifting techniques and room carrying weights that are too heavy. Damage may be cumulative and not necessarily immediate. When lifting keep the back straight in upright position, the less work is required from muscle and the less strain is imposed on spinal discs.

6. Heat:

Various industrial processes are done in presence of heat, Foundry worker has to face the excessive heat. The exposure of worker to heat leads to various health hazards. Heat stress of any work environment is considered as the combination of both climatic and nonclimatic factors. When the heat gain by the body exceeds the tolerance limits, it is necessary for the body to maintain the heat equilibrium, sweating, machinery starts and heat is lost through skin by evaporation of sweat.

The first response of the body to heat stress is discomfort and leads to thermal stress on the regulatory systems. The rise in internal temperature and increased sweat loss cause an increase in circulatory stress; viz, rise in pulse rate, drop in blood pressure, increased blood flow and loss of body water and salt. Thus heat stress results in heat stroke, heat exhaustion, heat cramps or muscle cramps, fainting, prickly heat or heat rash and trasient heat faigue. Heat tends to promote accidents by causing:- (i) Slipperiness of sweating palms, (ii) Dizziness, (iii) Fogging of safety glasses, (iv) Contact with hot surface, molten metal, steam etc., (v) Physical discomfort and fatigue.

To avoid this there must be thermal limits by legal provisions and other control measures by improving the working conditions Some control measures are as follows - (a) Use of

thermal barriers in between heat source and worker eg. Calcium-silicate reduces 40-45% of total heat. (b) Use of personal protective clothing made up of luminized fabric. About 50% improvement is achieved by this method (c) Reduction in metabolic workload by means of modernization of machinery and partly by adjustment of work and rest periods (d) Airconditioned rest-rooms helps in satisfactory recovery or rapid cooling of the body (e) Cold drinking water balances the body heat.

7. Radiations:

There are several types of electro-magnetic radiations, some harmless like radiowaves, some lethal like gamma rays. Microwaves will 'cook' any exposed part to the body, with severe physical and possibly mental effects. Inf rared radiations from red hot materials produces burns, eye cataracts even results in blindness. Ultra-violet radiations from arc-welding and sterlizing units results in skin leukamia and skin cancer.

8. Accidents:

Accidents are usually the results of lack of training specially in construction industry and by neglecting noise, vibration, high and low temperatures, stress, fatigue and narcotic fumes. Poor lighting, oil on floor, poor ventilation, uncleanliness and overcrowding are also the medias to increase the accident rate higher.

9. Fatigue:

As the energy supply to the working muscle is depleted,

the force of contraction lessens and eventually falls to zero. This drop in tension with prolonged stimulation is known as muscle fatigue. Sitting or standing in one position for a long period usually impose a strain on postural muscles, which is often experienced as uncertain aches and pains. Generally poor circulation of blood that results from such inactivity leads to felling of lassitude. Emotional stress caused by personal problems leads to psychological fatigue. Most fatigue probably results simply from inability of thecontractile and metabolic processes to continue supplying the same work output.

Increased heart rate, increased blood flow, increased blood lactic acid level, increased pulmonary ventilation, increased body temperature are the results of fatigue.

Application of healthy workers, elimination of adverse working conditions, tabulating the work and rest periods lessens the chances of fatigue.

Thus, the industrial workers are exposed to various health hazards and the working condition in the modern industries, on the other hand showing gradual elimination of physical activities. These are reasons to think that this tendency causing a deterioration in health among middle aged men. A study on physical fitness of the workers is carried out in the foreign countries such as U.S.A. UK. & West Germany etc.

To know the physical fitness of the workers has got many importances in the factories. Firstly, the management has a wide choise to select a right worker for the right job, and secondly, the fitness of worker is of prime importance from the production point of views.

The present literature showed that a little, rather nothing is known about physical fitness of the Indian workers. With this view the present study is undertaken. This study mainly deals with the physical fitness of the workers of various age groups in factory Kirloskar Hermetic Pvt.Ltd. in Satara district at Karad. The present study is also dealing with other physiological parameters of the workers, such as, heart rate, pulse pressure, blood pressure, PEFR. The study is carried out at factory environment by using well known techniques and latest equipments.

D. RESEARCH PLAN:

On the basis of literature and information available in connection with workers, industry, health hazards, it was decided to workout the physical fitness of the workers by using Harward step Test method. In addition to that the other physiological parameters such as heart-rate, peak-expiratory-flow-rate, blood-pressure, body-weight, body-height, oral temperature were also studied.

i) CHOICE OF THE SUBJECTS (WORKERS):

Workers were selected from various age-groups i.e. 21-

25, 26-30 - - - 56-60. Their selection were done from the various departments of the industry including machine-shop, tool room, washing section, Assembly, Maintainance, Development, stock despatch and Hydrolic deprtments. Selected workers were from average economic groups. Regularity of their presentee was also considered. Illhealthy workers were discarded. The selected workers would have better nutritionalstatus. Every employee was offered the examinations free of charge and the response rate was 100%. Examinations were carried out before start of their workshifts. 25 workers of each group were examined carefully except last two groups i.e. 51-55 and 56-60. From these last 2 groups 5 workers of each group were examined. The work was done in industrialpremises at Kirloskar Hermetics Pvt.Ltd., Karad in Satara district.

ii) TECHNIQUES TO BE USED:

In order to know the physical fitness of the workes, various techniques were used. The equipments used were modern, well conditioned, easy to use and handy, prior to start the physical examinations the workers were catagorised according to age groups. Their ticket numbers, Age, Body-Height and Body-weight were recorded. All the examinations were carried out in factory environment in a well ventilated room.

The physical and physiological examinations were carried out in resting conditions. Heart rate (beats/min.) recorded in resting (sitting) condition. Peak-expiratory-flow-rate was

recorded with the help of Wright Peak Flow Meter. Blood-pressure was recorded in supine position with the help of mercury sphygmomanometer. Oral temperature were recorded by using clinical Thermometer in ^{O}F. A modified step-test were carried out to know their physical fitness. Observations were done carefully and recorded neatly to make the successful investigation.

E. OUTLINE OF DISSERATION:

As per the principles of research methodology, the present dissertation is divided into four chapters. The first chapter being the introduction which explains about review of literature, reasons that led to undertake present investigation, research plan, choice of the subjects and techniques to be used. Chapter second, covers usual aspects like materials used and methods employed to make the successful investigation. Chapter third deals with observations made of the workers at industrial premises. Chapter fourth is devoted to the discussion on results obtained in the investigation undertaken and comparison with those obtained in other industrial workers (Foreign workers).

Discussion is followed by concluding remarks and complete bibilography of the references cited time to time in various chapters, to make the disseration perfect, giving no scope for erratum.