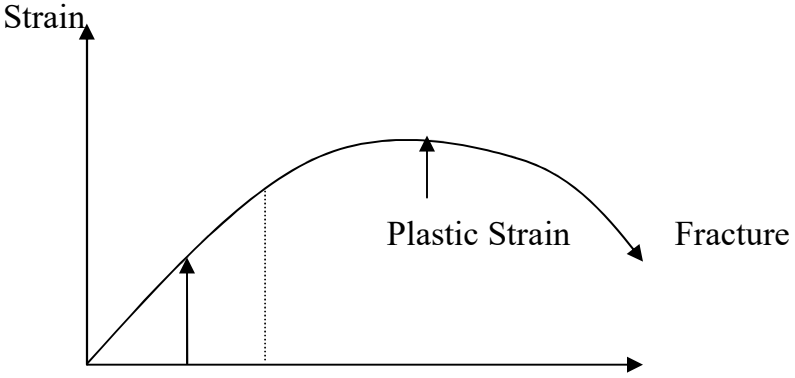
CHAPTER TWO

ANALYSIS OF CREEP MEASUREMENT APPARATUS

Creep is the continuous deformation with the passage of time when material is subjected to persistent stress. This deformation is plastic and occur if the applied stress is below the yield strength of the material. One of the approaches of interpretation of creep test data is to determine an empirical equation to fit a particular creep time curve at a given stress for a given temperate and material. A relationship between the creep strain, time and stress is required to select on allowable creep stress deformation. Microscopically material react to an applied stress. When the material strain is not permanent and return to zero after the applied stress is removed, it is elastic behaviour. The stress at which the material behaviour change from elastic to plastic is known as yield strength. In plastic deformation, strain is due to strain hardening. The process by which the material grows stronger as it deformed. There is another stress called ultimate tensile strength needed for further strain decreases result in necking of the material that is, decrease in the local area of the samples due to localization stress. If the material is plastically deformed too much, voids start to form which further weaken the material and eventually tears the material apart due to the ductile fracture.



Stress

0.2 offset yield point

Elastic Strain

Figure 2.1 Stress-strain Curve with distinct yield point.

For metals at higher values of stress or temperature, four distinct stages of creep are noticed. These stages are

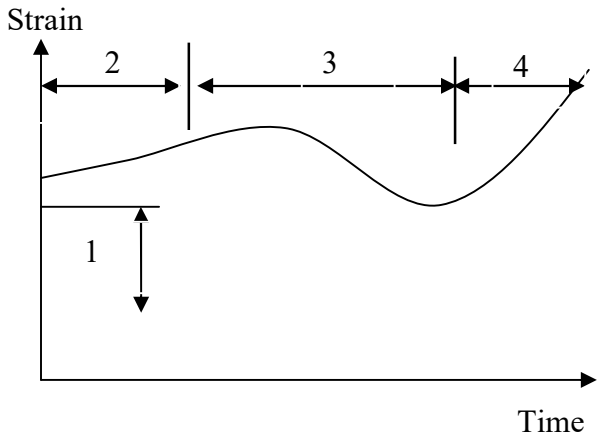
(1) Initial Stage:- in which the total deformation is partially elastic and partially plastic.

following an instantaneous elastic strain region, the curve generally has three parts. These are:-

(2) Second Stage:-A primary creep where the rate of creep deformation decreases with time, indicating the influence of strain- hardening

(3) Third stage:- A secondary creep or steady state creep where the strain Increases steadily with time. The effect of strain counteracted by an annealing influence, which result in a stage of constant minimum creep rate.

(4) Final stage:-Tertiary creep where the rate of creep deformation increases and eventually causes failure. During the tertiary creep period, there is reduction in the cross sectional area of the specimen leads to higher stress.



Stage 1= Initial elastic Strain

Stage 2= Primary Creep

Stage 3= Secondary creep

Stage 4= Tertiary Creep

Figure 2.2 The General Creep Curve.

As shown above creep is the plastic deformation of a material at a high temperature when subjected to a stress below the yield strength over a period of time. The effect of increase the stress and temperature is shown below.

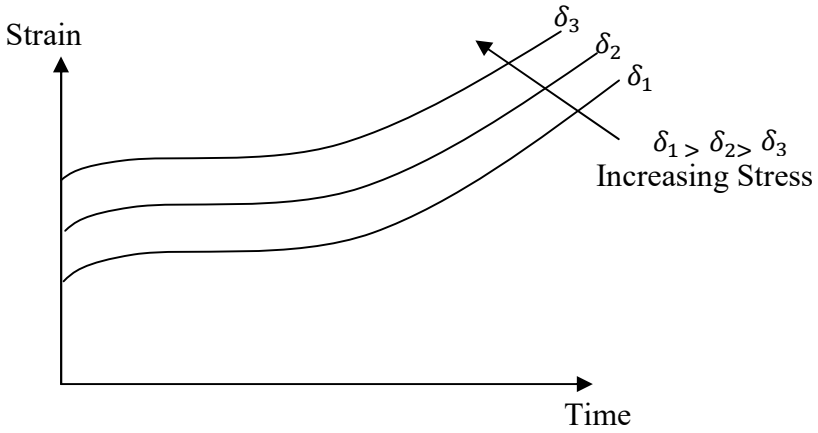


Figure 2.3 Effect of applied Stresses on the creep Curve

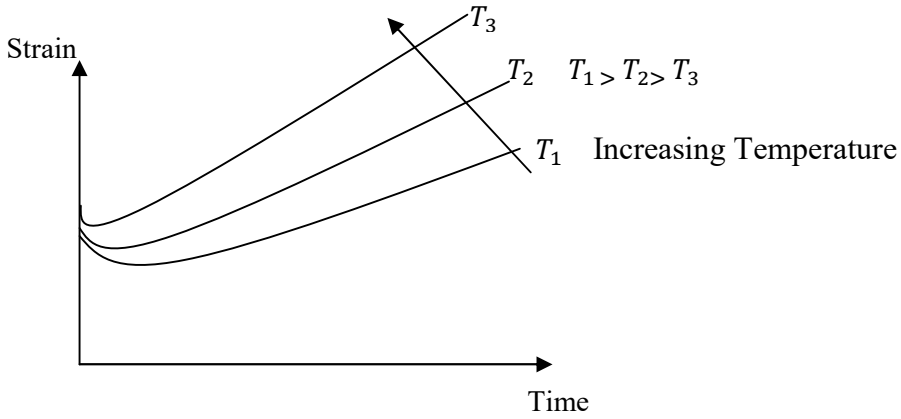


Figure 2.4 Effect of increase temperature on the creep-time curve.

2.1 RELATED CREEP MEASUREMENT APPARATUS.

There are various types of creep measurement apparatus. hey different size their sizes, capacities, mode of operation and the types of material they measured. These includes series 2100 direct load creep frames, series 2300/2500 lever arm creep frames and series 2600 pneumatic activated creep frames.

SERIES 2100 DIRECT LOAD CREEP FRAMES.

This is a type of creep measurement apparatus with a loading capacity up to about 44400N and used for stress rapture and creep. It is a low cost system and has a multi-station units that offer separate control for each individual component for maximum system flexibility. It is incorporated with electric weight elevator and automatically maintain a small clearance between the stack and injury upon specimen breakage.

SERIES 2300 LEVER ARM CREEP FRAMES

This is another creep measurement apparatus with a loading capacity up to 22240N. It is long life test machine to meet virtually any requirement. It comprises models available to perform stress relaxation and constant stress testing. It has manual or automatic leveling draw head as well as electric or hydraulic weight elevaators. All the model offer computer control with the versatile win CCSII soft ward from American Teaching System (ATS). This may involves flexibility test, preparation of specimen and generation of gueuing report and analysis of data.

SERIES 2600 PNEUMATIC-ACTUATED CREEP FRAMES

This apparatus is efficient and accurate for creep testing. It is designed specially for pneumatic actuator with frictionless rolling diaphram construction and non-rotating shaft with capacity up to 22200N. It as manual computer control with data acquisition, analysis and cyclic load capacity and more.

2.2 THE DESIGNED CREEP MEASUREMENT APPARATUS

The creep measurement apparatus constructed which is manually operation is a tension creep test. Specimen are usually subject to constant loads by lever system of loading. The creep information are usually measure by dial indicator with accuracy of 0.01mm and rang of 001-10mm which served as the extensometer to measured the extension for room temperature and the creep test at elevated temperature. The designed creep measurement apparatus with heating chamber consist of an electric furnace which is maintained at constant temperature with thermostatically controlled heater that are used to apply elevated temperature to the specimen.

2.3 CHOICE OF HEATING CHAMBER

Heat furnace are usually classified accordingly to the purpose for which the material is heated, the nature of the heat transfer to the material, the method of firing the furnace and method of handling the material through the furnace. The maximum temperatures are limited only by the nature of the material of the charge. The heating chamber are designed to operate at higher temperatures range. The temperature of the inner face of the heating chamber determines the characteristics of material required for the insulation. Fiber grass is used for insulation of the heating chamber, an insulator of this kind has less heat storage capacity and it use accordingly decreases the time period of heating and cooling the chamber and also decreases the stored heat loss for a given cycles of operation other advantages are its high heat insulating value and light weight.