Section 22: Tendon / Ligament – Mechanical and Viscoelastic Properties

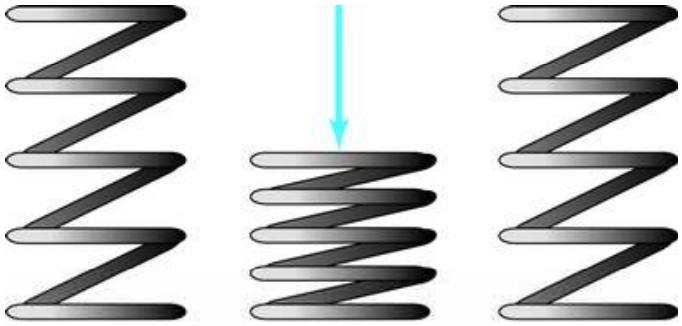
Viscoelasticity

- Time dependent behavior in soft hydrated cells & tissues
- Linear and nonlinear viscoelastic models frequently used to phenomenologically describe mechanical behavior of ligaments and other biological tissues
- Usually model based on curve fitting creep or relaxation experiment at one level of loading
- Most commonly used model is quasi-linear viscoelasticity (QLV)

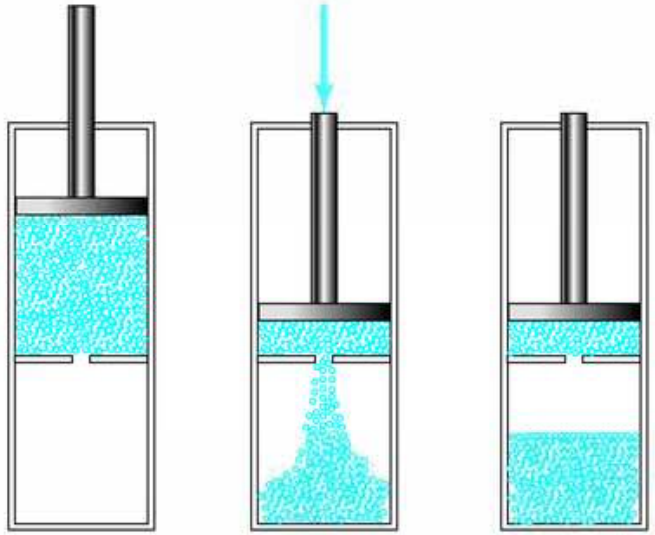
From: Vanderby

Viscoelasticity

- Increased resistance with increased loading rate
- **Creep** = under constant load soft tissue will continue to gradually deform
- If compressive force is applied slowly, syringe offers little resistance
- Increased rate of force, increased resistance to rate of motion of syringe



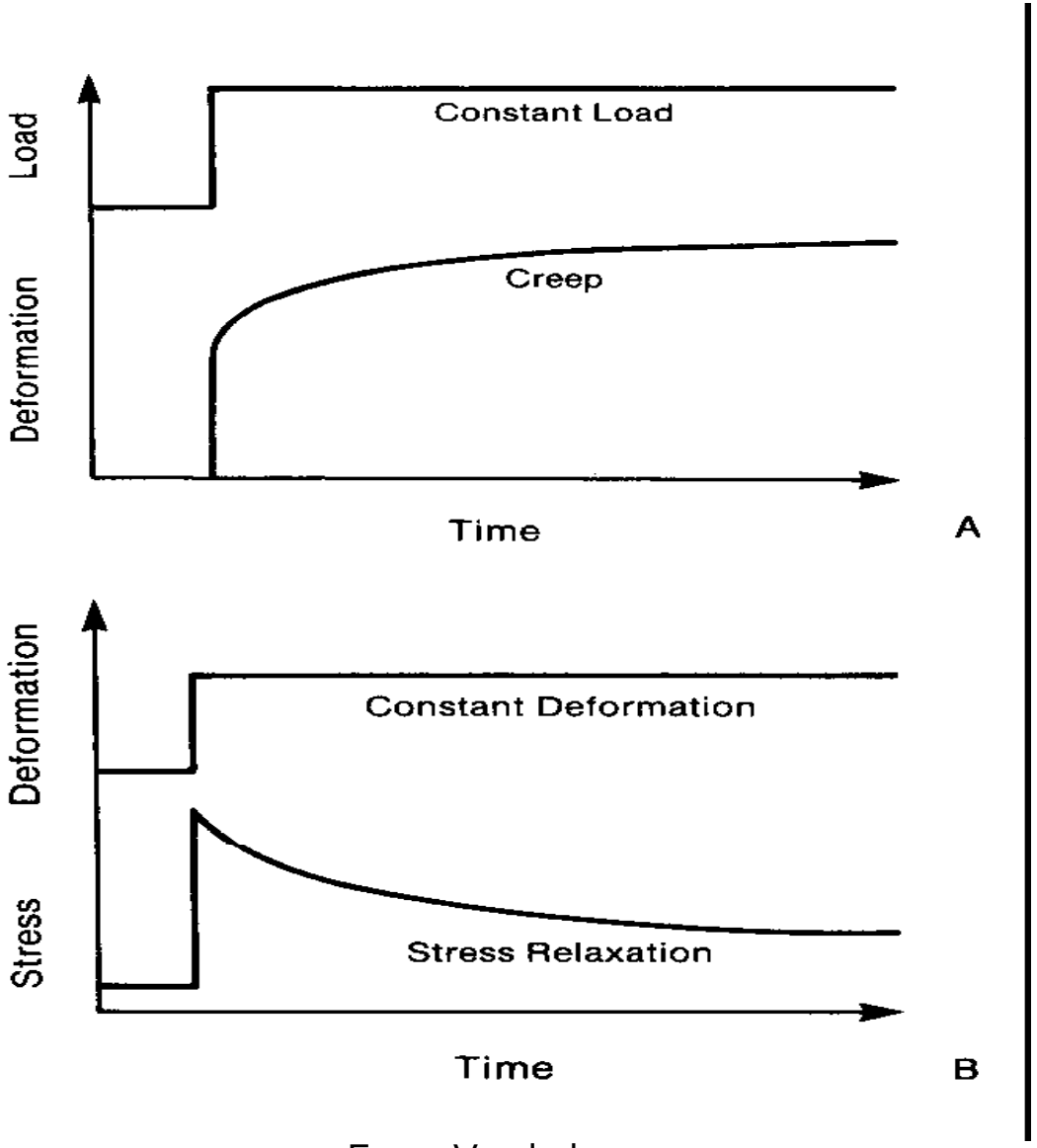
Spring (elastic component)



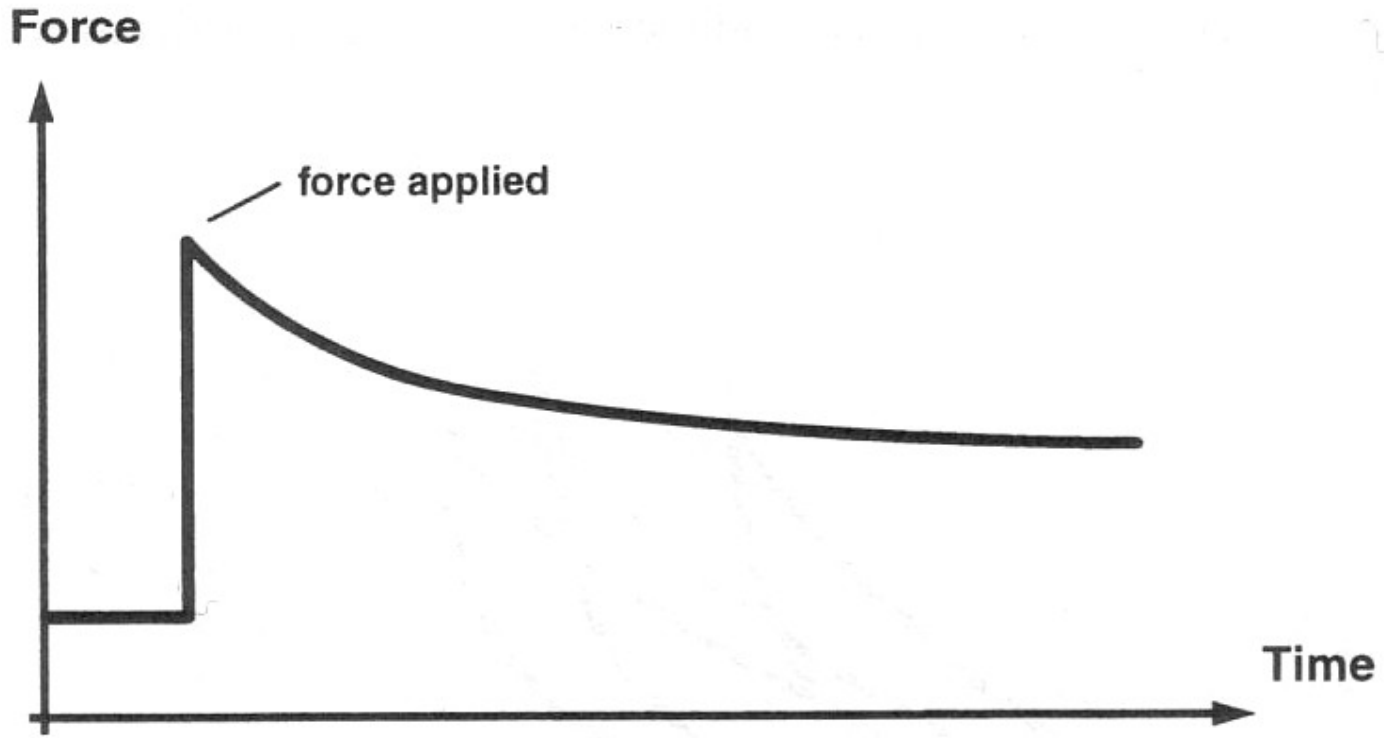
Syringe (viscous component)

From: Justice

Viscoelastic Behavior

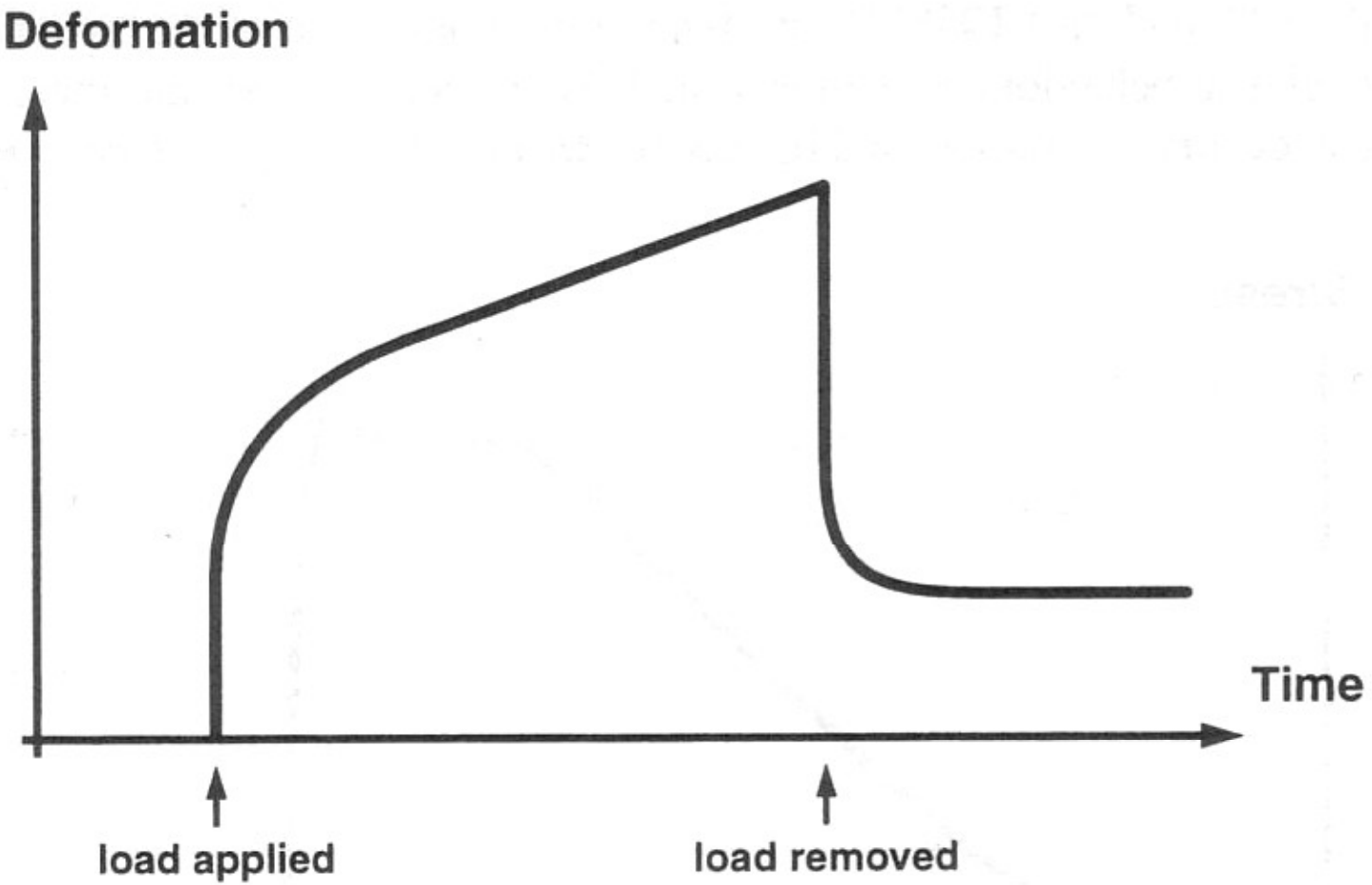


From: Vanderby



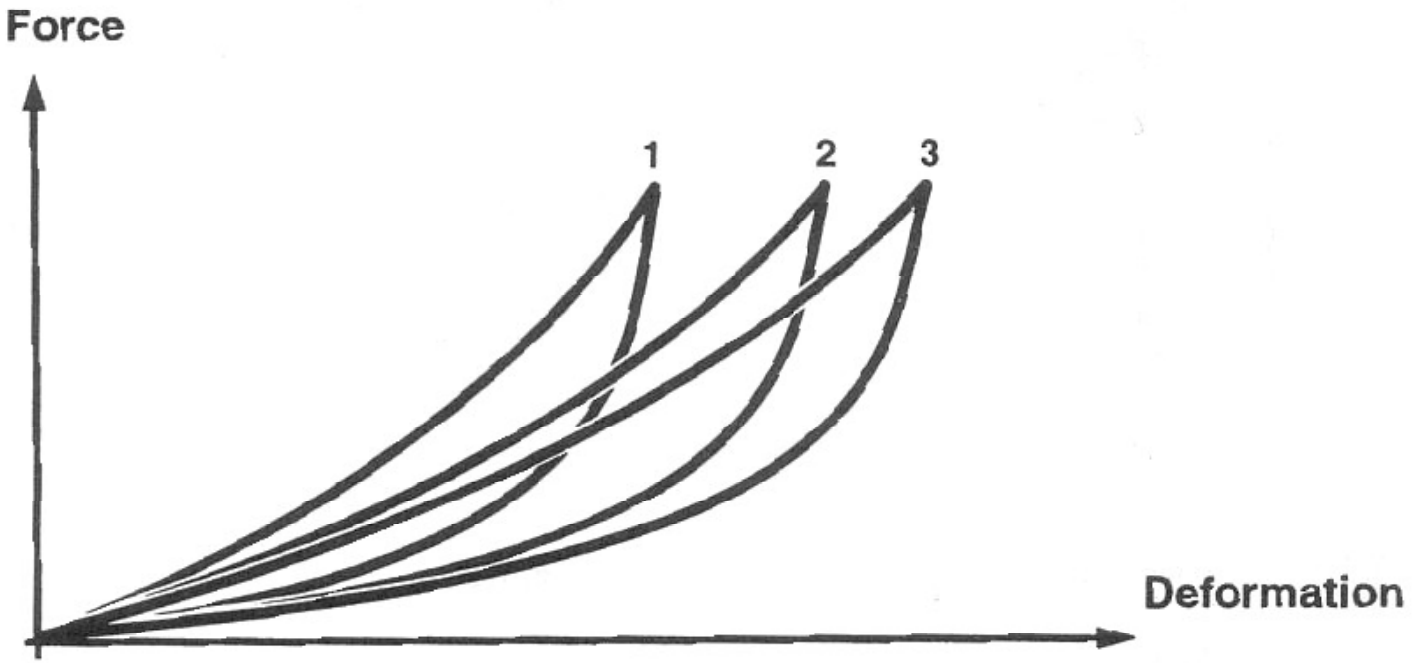
Schematic force-relaxation curve for ligament.

From: Garner



Schematic creep curve for ligament.

From: Garner

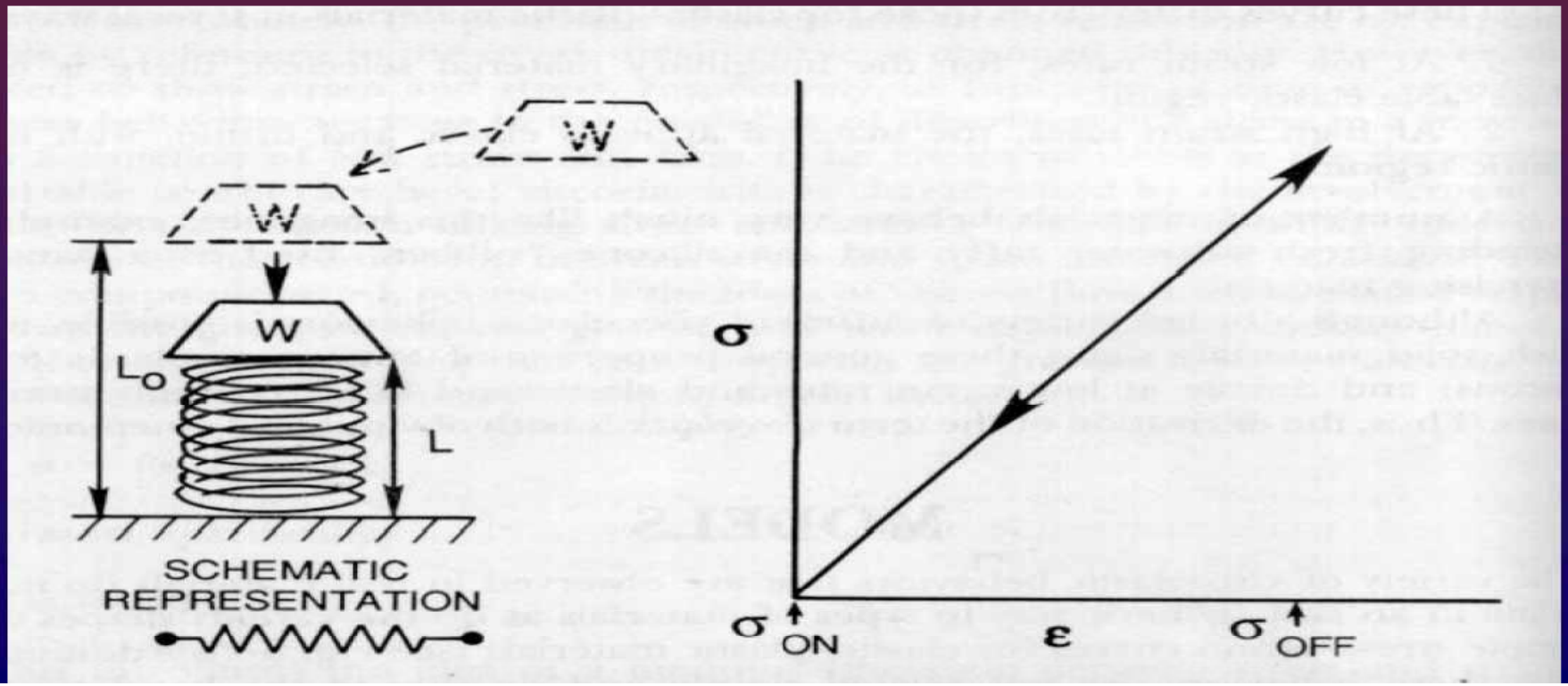


Schematic force-deformation graph showing three successive cycles of forcing and unforcing, illustrating the viscoelastic creep effect of cycling upon a ligament.

From: Garner

Viscoelastic Materials (cont)

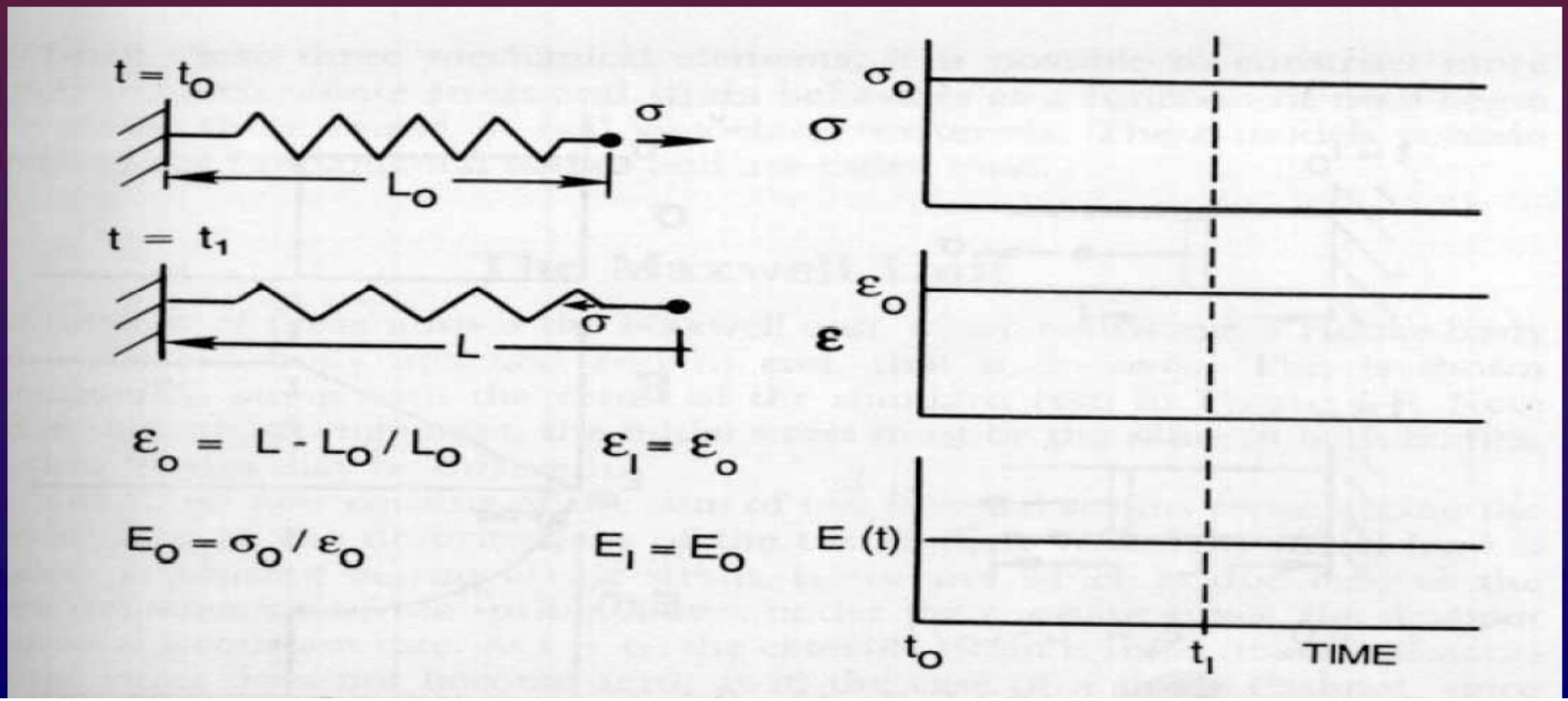
- Fully Elastic Behavior.



From: Al-Tayyar

Viscoelastic Materials (cont)

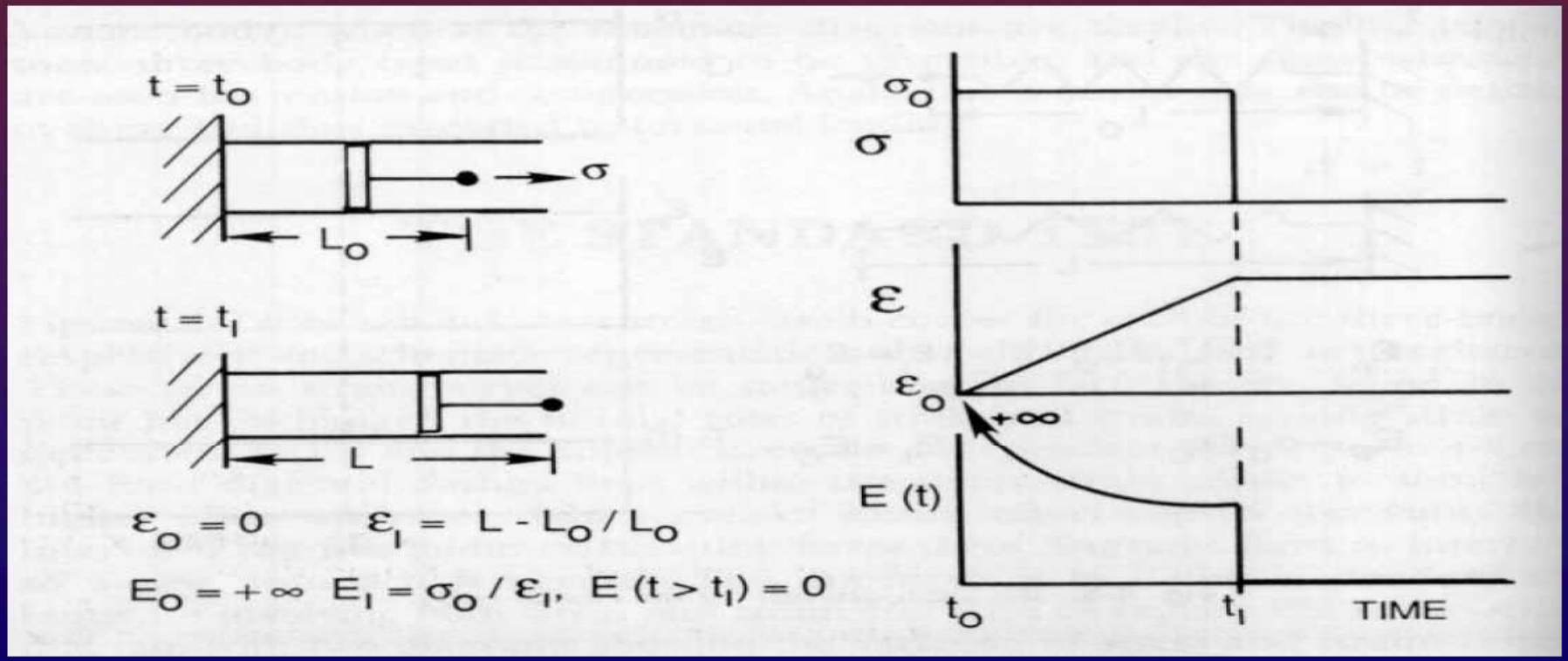
- Fully Elastic Behavior.



From: Al-Tayyar

Viscoelastic Materials (cont)

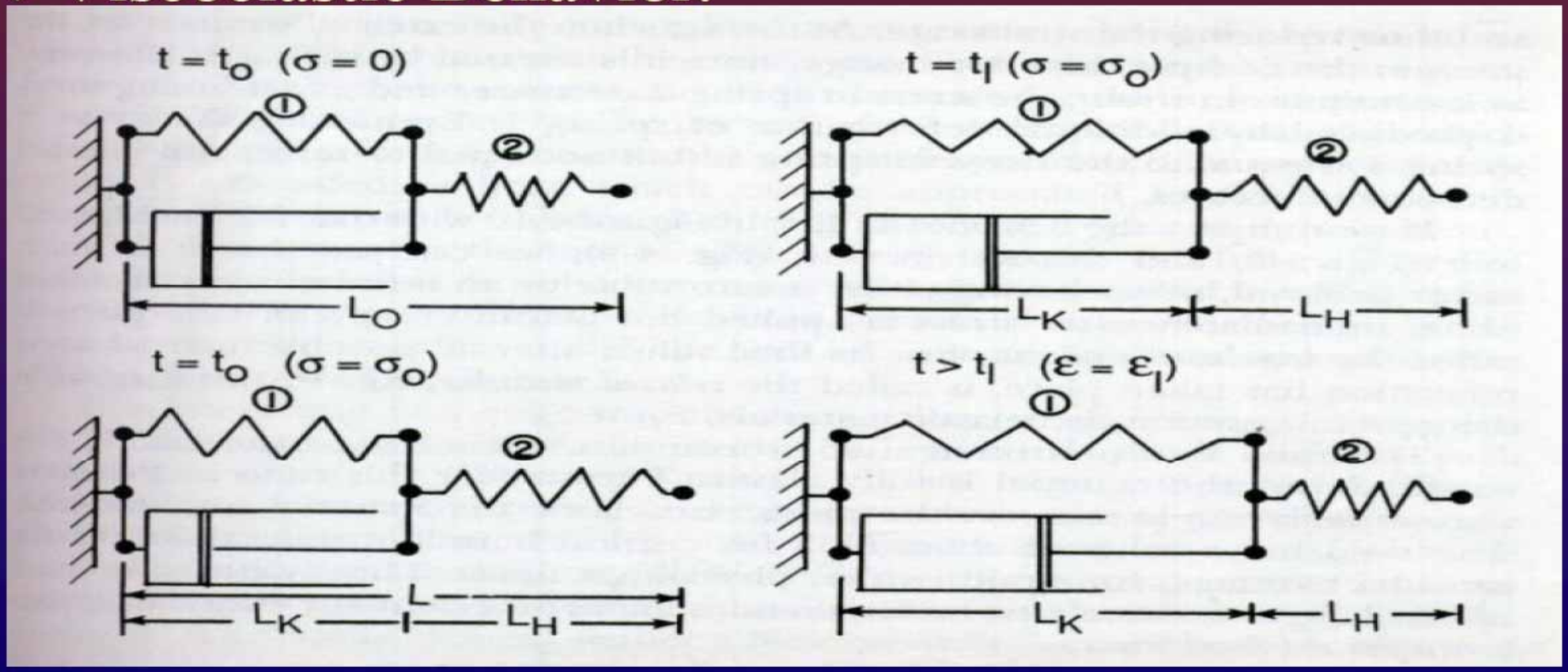
- Fully Viscous Behavior.



From: Al-Tayyar

Viscoelastic Materials (cont)

- Viscoelastic Behavior.



Viscoelastic Materials (cont)

- Viscoelastic Behavior.