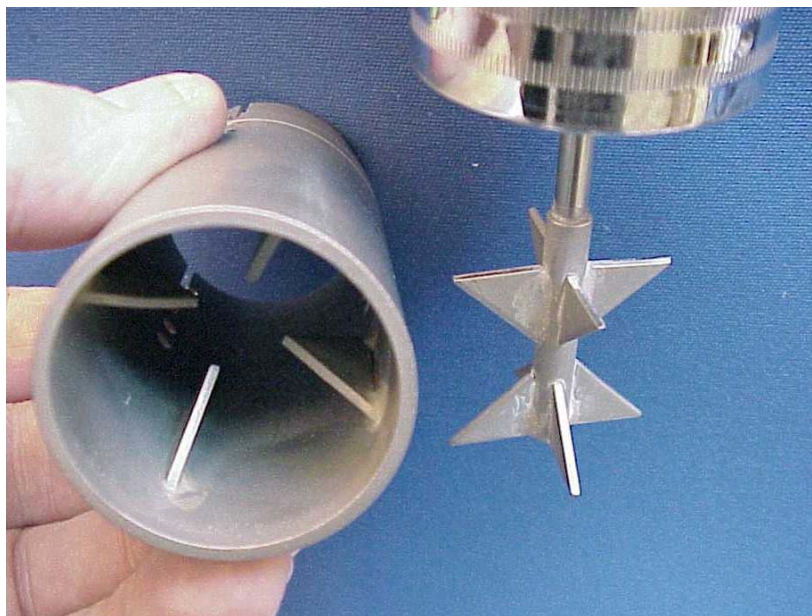


## YSA –Yield Stress Adapter for Multi-Phase Slurries

Most common viscometers used to measure rheology of oilfield fluids are simple concentric cylinder viscometers (Couette). Gap between bob and sleeve is small; particles can easily jam and lock-up the viscometer. Rotation of the sleeve creates centrifugal forces that cause particles to migrate and stratify in the radial direction. Standard oilfield viscometers do not rotate at low enough speeds (< 1 RPM preferred); nor sufficiently sensitive to measure low torque values required for either method.



Yield Stress Adapter

The solution is the Yield Stress Adapter (YSA). This is a Cost-effective method to convert a standard oilfield Couette viscometer (Fann Model 35 Viscometer) into an instrument that readily and accurately measures the yield point of various fluids such as particle-laden fluids, foamed fluids, emulsions, etc.

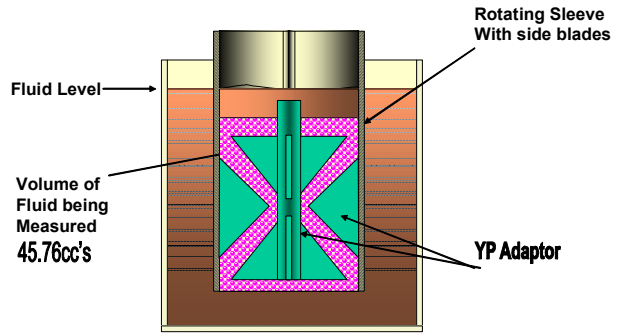
### Yield Point indicates a fluid's performance

- Drilling Fluids - YP relates to the fluid's ability to transport cuttings.
- Spacers/Pre-flushes - YP relates to the fluid's ability to remove drilling fluids and filter cake.
- Cementing Fluids - YP relates to the ability of the slurry to control gas migration.

## Directly Measuring Yield Stress

The YSA is lowered into a fluid and rotated at a low speed (3 and 6 rpm recommended). When steady torque develops during rotation, motor is quickly turned off, allowing the torque dial to reach steady state equilibrium.

- For inelastic cement samples, 15 sec. ample time.
- Elastic fluids such as cross-linked fracturing gels could require >100 sec. for torque decay to reach equilibrium.



### DM Method

- $Y_{P_i}$  method = Minimal shear stress required to initiate flow from a stationary position (torque vs. time profile after starting viscometer)
- $Y_{P_e}$  method = Equilibrium stress state a fluid retains as it comes to rest (torque decay carefully monitored after turning off the cylinder). The fluid retains an internal stress equal to the YP.

## Rheology Calculations

Yield Point – obtained by direct measurement

Plastic Viscosity – calculated by regression of shear rate versus shear stress as typically done with standard bob and sleeve

	Bob and Sleeve	YSA
Shear Rate ( $\dot{\gamma}$ ) (1/sec)	1.705 * RPM	0.33 * RPM
Shear Stress ( $\tau$ ) (lbf/100 ft <sup>2</sup> )	1.065 * F * torque	2.08 * torque

$$T = PV * \dot{\gamma} + YP$$

**Exception:** The YSA is not intended to be a total replacement for standard bob and sleeve viscometers. The standard bob/sleeve is still preferred for thinner fluids without particulates that are in viscometric flow.

**Order Part Number 101450793**

### Fann YSA Kit

Includes: Sleeve, Bob, Adapter – Bob to Shaft, Thread Protector, Set Screw, Balldriver Wrench 1/16"

**Fann Instrument Company offers a complete line of equipment, materials and supplies for use in analyzing Oilwell Cements in accordance with The American Petroleum Institute:**

API Specification 10A, ANSI/API 10A/ISO 10426-1-2001