TDI-BROOKS AUTO T-BAR SYSTEM

The TDI-Brooks Auto T-Bar instrument measures the progressive resistance of a soil column to a cylindrical rod (shaped as an upside-down **T**) as it is pushed down the soil column at a constant rate. The instrument is shown at right, with its T-bar protruding from the bottom.

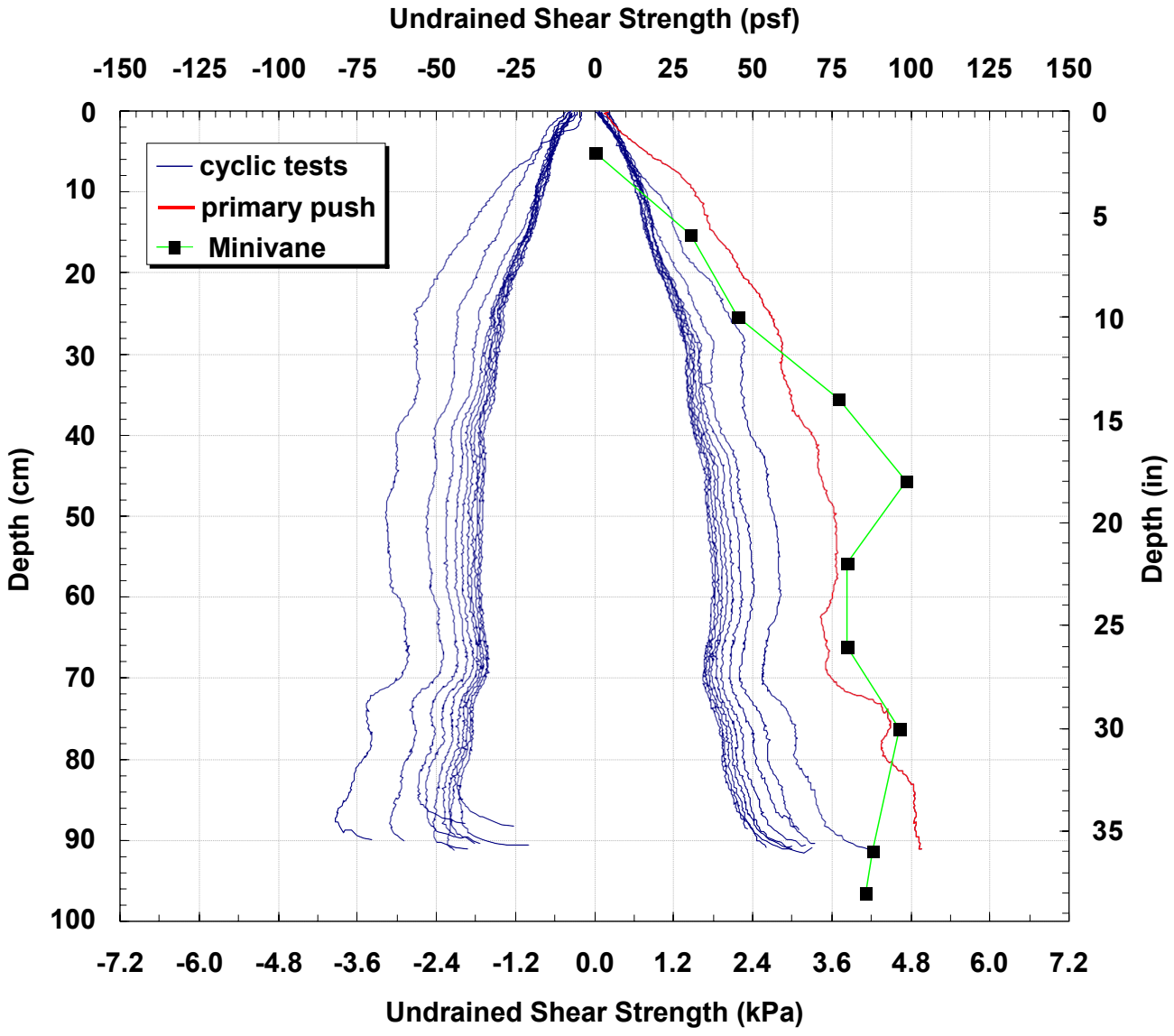
OVERVIEW

Operation consists of mounting the instrument onto a box corer containing an undisturbed seabed soil sample, connecting the instrument to a source of compressed air, and starting the automatic advance of the T-Bar into the soil sample. The resistance of the soil is automatically logged during the downward advance until the bottom of the soil sample is reached by the T-bar. The instrument then reverses T-bar movement and logs the soil resistance generated during the upward, retracing return of the T-bar back up to any desired soil depth or to the surface. This sequence of a downward stroke followed by upward re-trace through the failed soil can be immediately repeated as many times as desired. Sets of 10 such cyclic T-bar tests are typical in box cores.

The instrument logs the soil's resistive force on the T-bar 10 times per second. The T-bar auto-advances at 2 cm/sec, so a data set is logged every 2 mm of penetration. A single test to 100 cm soil depth thus takes 50 seconds with 500 resistance measurements logged. The resistive force is reported in pounds, and is converted by the processing program into units of pressure (ksf and kPa) by dividing by the cylindrical cross-sectional area of the T-Bar. The standard (medium) T-Bar cylinder diameter is 1.0 in. and its length is 5.00 inches. Smaller T-bars are also available for quick change-out, each with cylinder length 5 times its diameter. The attached rod that pushes the cylindrical T-bar is surrounded by a tube to eliminate sleeve friction on the rod, rendering its frictional drag to be immaterial. The calibrated range of the tool is -100 lb (upstroke) to +100 lb (downstroke), which translates to a dynamic range in undrained shear strength of -275 psf to 275 psf.

An example of 10 cyclic auto T-bar measurements into a 1-m deep box core sample are plotted below.

In this figure, the red trace represents the initial downward push of the T-bar into the soil. The two (right and left) nested sets of blue traces are the sub downstroke data, with the inner traces being the 10th and been converted using an $N_{t\text{-}bar}$ of 10.5 to be comparable to undrained shear strength. Same- sample miniature vane results are also plotted in green for reference. This plot illustrates the progression of soil reworking toward fully remolded character during the course of the 10 sets of strokes. Such a data set can thus be also used to project fully remolded values at selected soil depths.



Example Plot Of Auto T-Bar Cyclic Data

SPECIFICATIONS

Auto T-Bar Specifications

1. **Parameters Measured**: The instrument measures the following at a rate of 10 times/sec for up to 3 hours:
   a. T-bar Resistance (ksf)
   b. Displacement or stroke advance (cm)
   c. Load cell temperature (°C)
   d. Elapsed time (sec)
   e. Vertical Velocity (cm/sec)
   f. Manual events logged by button-push
2. **Conformance**: The instrument conforms to DeJong et al, Recommended Practice for Full-Flow Penetrometer Testing and Analysis, *Geotechnical Testing Journal*, Vol 33, No. 2, Paper ID GTJ102468, 2011, available from ASTM.
3. **Calibration Certification:** Load cell and stroke advance calibrations are performed prior to each job. Calibrations are certified as correct by an engineer with knowledge and experience materials testing for quality assurance. Applied forces are traceable to those retained by NIST.
4. **T-Bar dimensions**:
   a. Large T-bar: 5.00 in. long x 1.00 in. diameter, with a resulting cylindrical cross-sectional area of 0.03472 ft^2
   b. Medium T-bar: 3.75 in. long x 0.75 in. diameter, with a resulting cylindrical cross-sectional area of 0.01953 ft^2
   c. Small T-bar: 2.50 in. long x 0.50 in. diameter, with a resulting cylindrical cross-sectional area of 0.00868 ft^2
   d. Push rod: 0.313 in. dia x 38 in. stroke
   e. Push rod sleeve: 0.50 in. dia with 4.5 in. length of push rod exposed below sleeve bottom end
5. **T-bar Resistance Range**: Resistance is measured by a strain gauge attached to a temperature compensated load cell. Load cell calibrated range is 100 lb. Full scale response corresponds to a T-bar resistance in either advancing direction of
   a. Large T-bar: 2,880 psf
   b. Medium T-bar: 5,120 psf
   c. Small T-bar: 11,520 psf
6. **Shear Strength Range**: Full scale response corresponds to an undrained shear strength using $N_{t\text{-}bar}$ = 10.5 of
   a. Large T-bar: 275 psf
   b. Medium T-bar: 488 psf
   c. Small T-bar: 1,097 psf
7. **Materials**: The T-bars, push rod and sleeve are made of high strength stainless steel of a type and hardness suitable to resist wear due to abrasion by sand.
8. **Tool Dimensions & requirements**:
   a. Stand width: 9.0 in.
   b. Stand depth: adjustable from 9.313 in. to 9.875 in to securely mount in box corer
   c. Height with T-bar retracted: 54.0 in.
   d. Weight: 43 lb
   e. Rod stroke: 38 in. by pneumatic to hydraulic power using compressed air to water
   f. Battery life: 4 hours, rechargeable and indefinitely extendible with 115 VAC
   g. Push power: Compressed air pressure: 1 CFM at 110 psi, duration indefinite, no use of electrical power.