# Swell Test Apparatus
# SL285

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User Guide
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IMPACT

**General Information**

The SL285 Swell Test Apparatus is used to evaluate potentially dangerous swelling or shrinking conditions existing in some clay soils used in residential and commercial developments. Severe damage to building foundations, walls, and floors can result when alteration of moisture in these soils causes volume change. This device yields PVC values which refer to the maximum possible volume change that a soil could undergo when subjected to changing moisture conditions.

Easily operated, the SL285 includes: a 4.5 kN capacity proving ring, mould assembly, loading cap, porous stones, loading pistons, 70 mm diameter specimen ring and conversion charts.

**Preparation of Sample**

A. Remove approximately one pint of soil from the soil layer in which the foundation will be placed.

B. Air dry sample by breaking the soil into small lumps and leaving it in the sun for a few hours.

**Use of Compaction Hammer**

A. Place the compaction hammer on the soil in the ring with the hammer sleeve vertical and the rubber handle at the top. Make sure that the sleeve of the hammer rests inside the rings so that the hammer does not damage them in falling.

B. With one hand hold the sleeve in position.

C. With the other hand grasp the rubber handle and pull it all the way up until it is stopped by the top of the sleeve; then drop the hammer by releasing the handle. This constitutes one blow, with the bottom of the hammer hitting the soil surface.

D. Repeat pulling the handle to the top limit and dropping the hammer as often as prescribed for the particular test.

**Compaction of Sample**

A. Disassemble the Swell Test Apparatus.

1. Remove crosshead (#11 Figure 1) and proving ring (#2) by loosening hex nuts (#21) at top of each rod. The rods may remain screwed into the base (#1 0) but place the crosshead and proving ring where it will not be jarred during compaction.

2. Unscrew and put aside the lucite container (#18) . Leave O·ring (#22} in place.

3. Remove compaction ring (#15) and spacer ring (#16) by unscrewing the 3 bolts (#23) holding them to the base (#1 0).

4. Wipe equipment with clean cloth.

B. Assemble meter for compaction.

1. Fit compaction ring (#15--the thicker ring) on base (#1 0) and align bolt holes with those in base.

2. Place spacer ring {#16) on compaction ring so the radial grooves are at top and align bolt holes with those in base.

3. Insert the 3 bolts (#23} through both the rings and the base and tighten firmly to base.

C. Place soil sample in ring assembly in 3 layers of equal amounts, compacting each layer separately by use of the hammer.

1. Place 3 heaping teaspoonsful of sample in ring assembly and smooth lightly with hammer to firm up the surface before applying the blows. (This reduces the amount of soil "jumping" out of the mold during compaction.)

2. Place apparatus on a solid level floor.

3. Position sleeve of hammer 3 mm from soil and hold firmly against the inside of the spacer ring (#16). Be sure hammer sleeve rests inside rings so that hammer does not damage them in falling. Hold sleeve and hammer perpendicular and in line with supporting rods (#12).

4. Raise hammer to top of sleeve and let it fall free (not striking sides of sleeve). Space blows evenly over surface of sample by shifting hammer after each blow.

5. Repeat the process described in steps 1 - 4 for each layer, compacting the first two layers with 7 blows each. After compacting both the first and second layers, scratch the top surface of the layer with a knife to assure proper bond with the next layer.

6. Compact the last layer with a blows. After compaction, the last layer should extend approximately 6.35 mm into the spacer ring (#16). If it is significantly below this point, remove entire sample and recompact.

D. Put assembly on table and remove the 3 bolts {#23). Rotate spacer ring (#16}, to break bond between ring and soil, and remove carefully from sample. Rotate compaction ring (#15), to break bond between base and soil, and remove ring with sample from assembly.

E. Trim top of the sample in the compaction ring (#15) with a knife.

1. Hold knife against the compaction ring (#15) at all times during trimming to avoid dislodging sample.

2. Trim in a sawing motion, taking off only a small amount of soil at a time. Rotate the ring as you trim. Work from the edge toward the center.

3. When sample is almost level, do final leveling by drawing a metal straight edge over sample.

4. The final surface of the soil sample should be firm and smooth. Fill any voids by pressing additional soil into them with the knife or spoon.

5. Clean soil from base and from all holes in rings and base. With a toothpick or paperclip, remove soil in the groove of the spacer ring (#16) and from the holes in the spacer ring and the compaction ring {#15).

**Test Procedure**

The swell index test is essentially a measurement of the pressure exerted by a sample of compacted soil when it swells against a restraining force after being wetted.

A. Place spacer ring (#16 Figure 1) on base (#10) with radial grooves on top. Align bolt holes with those on base.

8 . Place thoroughly dry porous stone (#14) in spacer ring (#16).

C. Pick up compaction ring (#15) containing sample, trimmed side up. Carefully turn upside down the compaction ring containing sample and place flush against porous stone in spacer ring (#16).

D. Align bolt holes in the two rings. Move compaction ring (#15) with as little disturbance of sample as possible. Boll rings tightly to base.

E. Place a dry porous stone (#14) on top of sample inside compaction ring (#15).

F. Replace lucite container (#18) onto base, screwing it tightly to ensure water seal.

G. Place loading disc (#17) on porous stone (#14) with the center indentation at the top.

H. Place crosshead (#11) with proving ring (#2) on the supporting rods (#12). (Be sure that the adjustable rod which extends down from the proving ring dial does not strike the cover.) Add washers and nuts, then tighten firmly.

I. Set proving ring (#2) dial to zero by moving the band around the dial face. Tighten the dial with the screw next to the top or the band. Push up on proving ring dial to see that it appears to work properly.

J. By loosening nut (#14), turn adjustable rod exactly into the center of the indentation on top of the loading disc (#17}. Be sure that the loading disc is centered exactly over the stone. Firmly tighten lock nut (#14) on adjustable rod. Be sure adjustable rod does not stick in loading disc.

K. Again loosen nut {#14) to turn adjustable rod until dial reads one division past zero. Tighten lock nut (#14) firmly until adjustable rod has no play.

L. Record the time and the proving ring reading.

M. Add water to sample by squeezing from squirt bottle into the holes located at the top of compaction ring (#15) until water level in lucite container (#18) has covered the spacer ring (#16) and tops of the bolts. (This procedure is used to reduce the amount of air entrapped in the ring assembly and thus ensures that the sample has uniform access to water over its entire top and bottom surfaces.)

N. Allow soil to expand until completely stabilized or for a maximum of 2 hours, then read proving ring dial.

**Interpretation of Dial Reading**

A. To obtain the approximate PVC category and plasticity index, take the reading from the proving ring dial directly to the table in Figure 5. Established on the basis of the swelling and shrinking behavior of the soil, the following categories of PVC have been established:

| **PVC Rating** | **Category** |
|---|---|
| Less than 2 | Noncritical |
| 2 to 4 | Marginal |
| 4 to 6 | Critical |
| Greater than 6 | Very Critical |

B. To obtain a more exact PVC category and plasticity index, refer to the tables prepared for your specifically calibrated unit. These tables (in pounds, kilograms, and newtons) are separately supplied with this manual.

1. To calculate the equivalent swell index value in pounds per square foot, take the reading from the proving ring dial and subtract the one division that registered on the dial prior to swell.

2. Use this number on the proving ring calibration table to find the load in pounds.

3. Calculate the equivalent swell index value in pounds per square foot by dividing the toad (in pounds) by the area of the specimen (.04164 SQ. ft.}.

**Example:**

Proving ring dial indicator reading less .0001" (1 div.) = 58

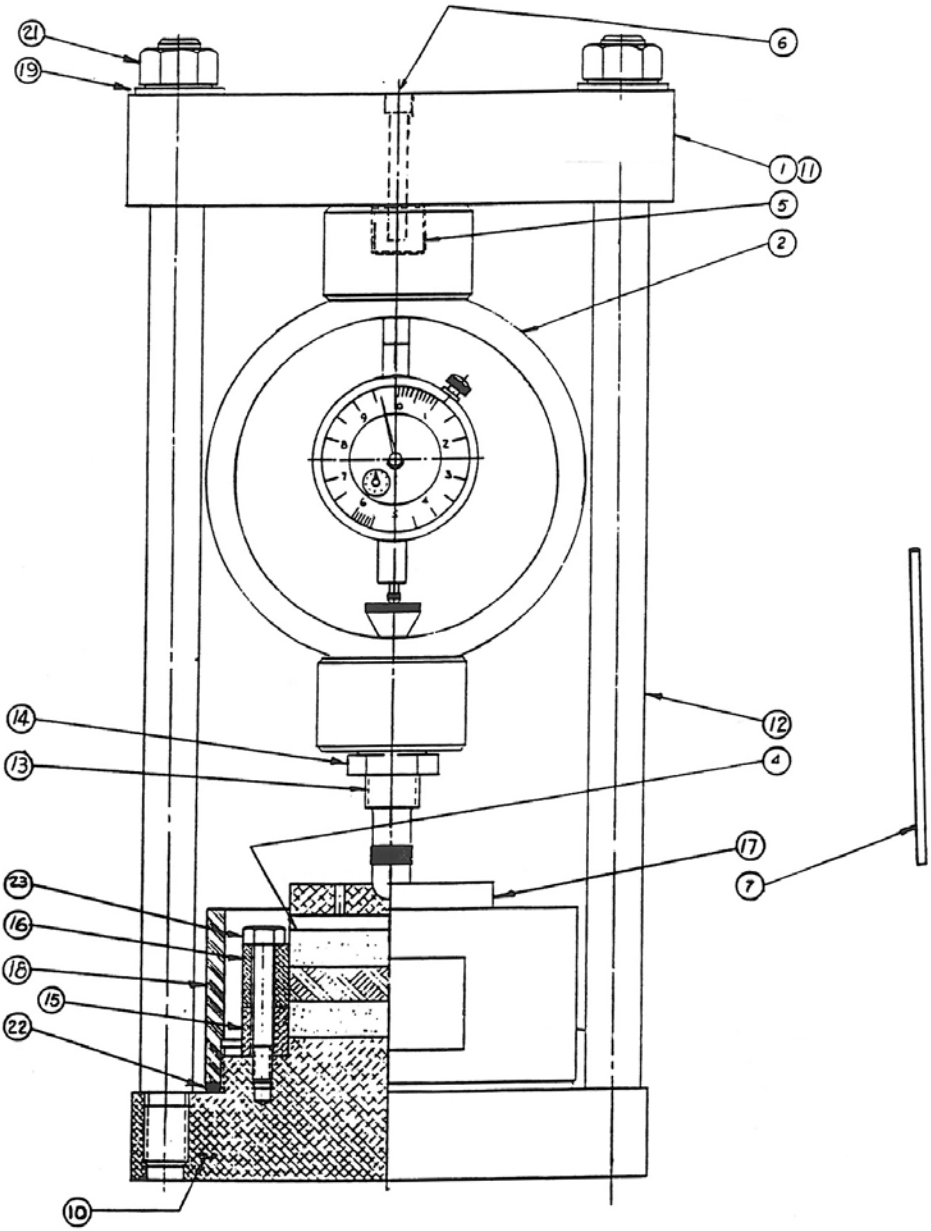
Corresponding load from proving ring calibration table = 200 lb. (This reading is for a fictitious proving ring .}

Swell index value in lb./sq. ft. $\frac{= 200}{.\ 04164}$ = 4803 lb./sq. ft ·

4. Use the swell index values calculated as above in pounds/square foot on the graphs in Figure 3, figure 4, and Figure 5 for determining the PVC category and plasticity of the soil.

**Specifications**

| | |
|---|---|
| Mould Assembly: | Includes porous stones and loading cap |
| Proving Ring: | 4.5 kN capacity; dial indicator |
| Other Components: | Loading pistons; compaction hammer |
| Specimen Ring: | 70 mm diameter |
| Sample Size: | 10 teaspoons |
| Water Required: | 5 oz. |
| Charts: | Convert readings to lbs./sq. ft. and then to PVC (Potential Volume Change) rating |
| Dimensions: | 184mm diameter base x 394mm |
| Weight: | Net 11.3 kg) |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**Parts List**

| Item | Description | Requred |
|---|---|---|
| 1 | Frame Pot. Vol. Change Meter | 1 |
| 2 | 4.5kN Single Proving Ring | 1 |
| 3 | Standard Compaction Hammer (Not Shown) | 1 |
| 4 | Corundum Porous Stone | 2 |
| 5 | Proving Ring Adapter | 1 |
| 6 | ~-20 x 1 3/4 Soc.Hd.Cap Screw | 1 |
| 7 | Cleaning Rod | 1 |
| 10 | Base | 1 |
| 11 | Crosshead | 1 |
| 12 | Supporting rod | 2 |
| 13 | Adjusting Screw | 1 |
| 14 | Lock Nut | 1 |
| 15 | Compaction Ring | 1 |
| 16 | Spacer Ring | 1 |
| 17 | Loading Disc | 1 |
| 18 | Lucite Container | 1 |
| 19 | Washer | 2 |
| 21 | Hex Nut 5/8-11 Th'd - St'l | 2 |
| 22 | "O"Ring 4~1.0 . X 4 3/4 0.0. X 1/8 | 1 |
| 23 | 5/16 -18 x 2 Hex Hd. Scr. | 3 |

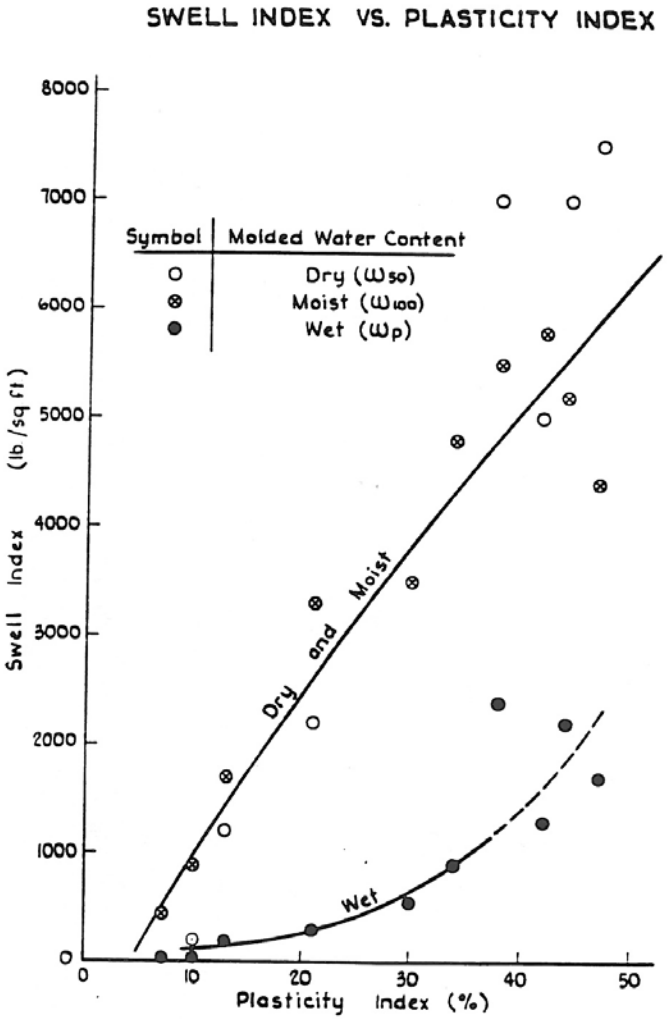
Figure 5 - Conversion Table

**TABLE FOR CONVERTING PROVING RING READINGS TO PVC CATEGORY AND APPROXIMATE PLASTICITY INDEX**

| Proving Ring Reading | Swell Index (#/SF) | PVC Category | Plasticity Index (%) |
|---|---|---|---|
| 5 | 775 | 0.8 | 8.5 |
| 6 | 925 | 1.0 | 9.5 |
| 7 | 1075 | 1.2 | 10.7 |
| 8 | 1250 | 1.4 | 11.7 |
| 9 | 1375 | 1.4 | 12.7 |
| 10 | 1550 | 1.8 | 13.8 |
| 10.8 | 1675 | 2.0 | 14.6 |
| 11 | 1700 | 2.0 | 14.8 |
| 12 | 1875 | 2.2 | 15.8 |
| 13 | 2025 | 2.4 | 17.0 |
| 14 | 2175 | 2.65 | 18.0 |
| 15 | 2350 | 2.85 | 19.0 |
| 16 | 2500 | 3.05 | 20.0 |
| 17 | 2675 | 3.3 | 21.5 |
| 18 | 2800 | 3.45 | 22.5 |
| 19 | 2975 | 3.7 | 23.8 |
| 20 | 3150 | 3.9 | 25.0 |
| 20.3 | 3200 | 4.0 | 25.5 |
| 21 | 3300 | 4.1 | 26.0 |
| 22 | 3450 | 4.3 | 27.5 |
| 23 | 3600 | 4.5 | 28.5 |
| 24 | 3775 | 4.75 | 29.8 |
| 25 | 3925 | 4.95 | 30.8 |
| 26 | 4075 | 5.15 | 31.8 |
| 27 | 4225 | 5.4 | 33.0 |
| 28 | 4375 | 5.55 | 34.0 |
| 29 | 4525 | 5.75 | 35.3 |
| 30 | 4700 | 5.95 | 37.0 |
| 30.2 | 4725 | 6.00 | 37.1 |
| 31 | 4850 | 6.2 | 38.0 |
| 32 | 4975 | 6.35 | 39.0 |
| 33 | 5125 | 6.5 | 40.4 |
| 34 | 5275 | 6.7 | 41.7 |
| 35 | 5425 | 6.9 | 43.4 |
| 36 | 5575 | 7.1 | 44.2 |
| 37 | 5725 | 7.25 | 45.5 |
| 38 | 5850 | 7.4 | 46.6 |
| 39 | 6000 | 7.5 | 48.0 |
| 40 | 6150 | 7.65 | 49.5 |
| 40.5 | 6225 | 7.7 | 50.0 |

Prepared by the Architectural Section, Federal Housing Administration Insuring Office, San Antonio, Texas

Figure 4 - Swell Index Vs. Plasticity Index

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