

Purpose

The **CAPO-TEST** permits performing pullout tests on existing structures without the need of pre-installed inserts. **CAPO-TEST** provides a pullout system similar to the **LOK-TEST** system (page 75) for accurate on-site estimates of compressive strength. Procedures for performing post-installed pullout tests, such as **CAPO-TEST**, are included in ASTM C900.

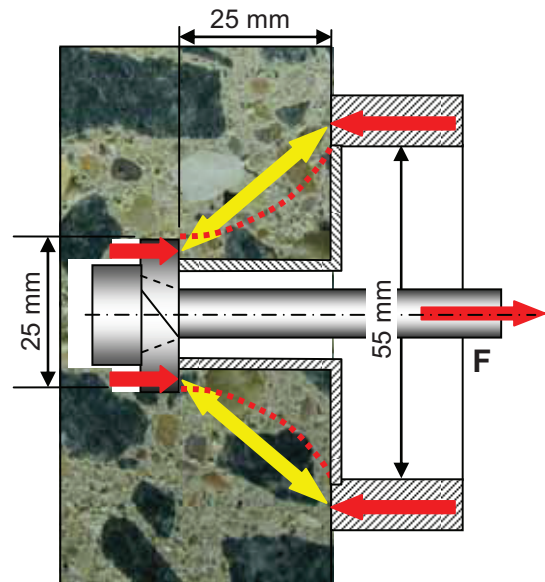
Typical applications of the **CAPO-TEST** include the following:

- Quality control of the finished structure
- Verification of in-place strength when strength of standard-cured specimens fails to meet acceptance criteria
- Estimating residual strength of concrete in existing structures
- Evaluation of fire-damaged structures
- Integrity of structures

Principle

When selecting the location for a **CAPO-TEST**, ensure that reinforcing bars are not within the failure region. The surface at the test location is ground flat and a 18.4 mm hole is cored perpendicular to the surface. A recess (slot) is routed in the hole to a diameter of 25 mm and at a depth of 25 mm. A split ring is expanded in the recess and pulled out using a pull machine reacting against a 55 mm diameter counter pressure ring. As in the **LOK-TEST**, the concrete in the strut between the expanded ring and the counter pressure ring is in compression. Hence, the ultimate pullout force F is related directly to compressive strength.

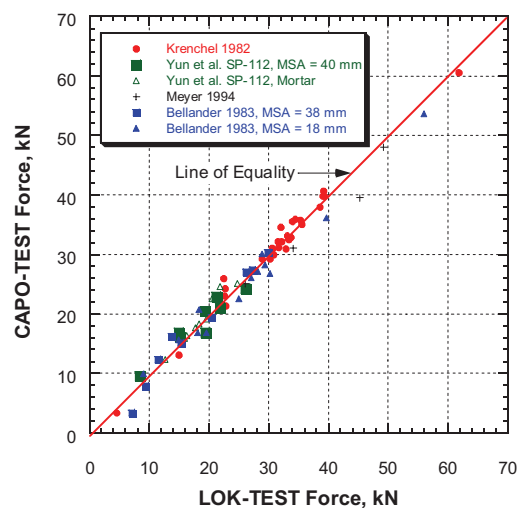
The test is performed until the conic frustum between the expanded ring and the inner diameter of the counter pressure is dislodged. Thus there is minor surface damage, which should be repaired for aesthetic reasons or to avoid potential durability problems.



Correlation and Accuracy of Estimated Strength

Several investigations have shown that the pullout strength measured by the **CAPO-TEST** is essentially the same as the pullout strength measured by **LOK-TEST**. This equality is illustrated in the graph to the right, which includes data from four independent studies. The maximum aggregate size varied from mortar up to 40 mm. Thus the general correlations for the **LOK-TEST** shown on page 76 are also valid for the **CAPO-TEST**.

Based on testing experiences and laboratory studies, it has been found that the accuracy of the compressive strength estimated by the **CAPO-TEST** using the general correlations shown on page 76 is similar to results obtained with the **LOK-TEST**. For normal density concrete, the coefficient of variation of individual **CAPO-TEST** results is about 8 %.

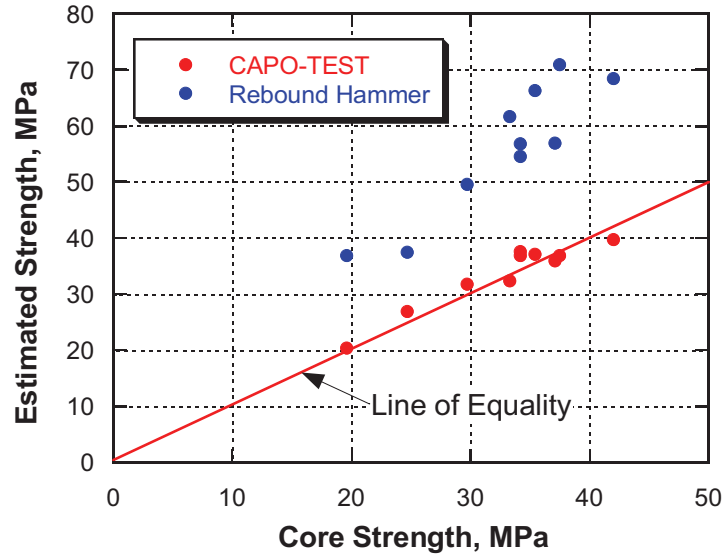


CAPO-TEST

Comparison with Core Strength

An investigation on 10 bridges compared the strength of cores with strengths estimated on the basis of the **CAPO-TEST** and the rebound hammer test (ASTM C805). As shown in the following figure, strengths estimated by the **CAPO-TEST** were on average within 6 % of the core strength. This study confirms the inherent reliability of pullout testing for estimating in-place compressive strength.

Reference: Moczko, A., "Comparison Between Compressive Strength Tests From Cores, CAPO-TEST and Schmidt Hammer," Wroclaw Technical University, Poland, 2002.



Example Applications



*Routing recess for the expandable ring in preparation for **CAPO-TEST** to evaluate surface strength of an industrial floor slab*



*View of valid **CAPO-TEST** of a slab. Note the well formed failure ring on the surface of the slab.*



***CAPO-TEST** being performed in parking garage to evaluate in-place strength of suspect concrete*

CAPO-TEST Equipment and Ordering Numbers
Inserts and Resizing Tool

C-112 CAPO expandable inserts

C-111 Resizing Tool
For resizing C-112 insert 2 to 3 times
CAPO-TEST Kits

The **CAPO-TEST** kits includes C-101 Preparation Kit, the C-102 DSV-Kit and a pull machine kit, either the C-103 kit containing a pull machine with the 0 to 60 kN analog dial gauge or the C-104 kit containing a pull machine with the 0 to 100 kN digital gauge.

C-101 CAPO-TEST Preparation Kit

This kit is used to drill the center hole and to cut the recess to accommodate the expandable insert. The kit also contains the unit for expanding the **CAPO-TEST** insert and other miscellaneous tools for conducting the test.



Item	Order #
Counter pressure	C-142
Expansion unit	C-101-1
Water pump	C-150
Recess router unit	C-101-2
Distance piece, 25 mm	C-136
Bottle w. CAPO-Oil	C-143
Diamond drill unit	C-101-3
Electric drill	C-101-4
Wrench, 14 mm	C-151
Wrench, 19 mm	C-155

Item	Order #
Screwdriver	C-149
Tweezers	C-148
Plastic hose	C-157
Marking chalk	C-160
Pliers	C-147
Allen key, 4 mm	C-156
Wrench, 46 mm	C-147-1
Wrench, adjustable	C-147-2
Vernier caliper	C-135
Attaché case	C-160

C-102 DSV-Kit

The kit includes the diamond planer, the suction plate, a vacuum pump, and the necessary tools for grinding the surface so that it is flat before drilling the center hole and routing the recess. The diamond planer, the diamond core drill unit, and the recess router are positioned in the recess of the suction plate for proper alignment and dimensional control.



Item	Order #
Diamond planer	C-102-1
Vacuum pump w. hose	C-102-4
Centering brass tap	C-102-5
Suction plate	C-102-2

Item	Order #
Clamping pliers, 2	C-102-3
Small screwdriver	C-158
Wrench, 17 mm	C-154
Plastic hose	C-147
Attaché case	C-161

CAPO-TEST

Two pull machines are available for the **CAPO-TEST**. These are the same machines as used for the **LOK-TEST**.

C-103 CAPO Pull Machine Kit

The hydraulic pull machine comes with a calibrated 0 to 60 kN analog gauge. Alternatively, the instrument can be supplied with a 0 to 40 kN gauge (Order No. L-10-2) for testing up to 40-MPa concrete. The pull machine accuracy is within 0.6 %, exceeding the ± 2 % requirement of ASTM C900.



Item	Order #
Hydraulic pull machine with analog gauge	L-10-3
Oil refilling cup	L-24
Oil refilling bottle	L-25
Large screwdriver	C-149
Small screwdriver	C-157
Manual	C-165
Attaché Case	C-166

C-104 CAPO Pull Machine Kit

The hydraulic pull machine has a calibrated 0 to 100 kN precision electronic gauge with memory for storage of test results (peak-value, time and date of testing). The peak-value is shown after a test has been terminated. The internal resolution of the gauge is 0.01 kN, but the pull force is displayed to the nearest 0.1 kN.



Item	Order #
Hydraulic pull machine with electronic gauge	L-11-1
AMIGAS printing software	L-13
Cable for printer	L-14
Oil refilling cup	L-24
Oil refilling bottle	L-25
Large screwdriver	C-149
Small screwdriver	C-157
Calibration table	L-32
Manual	L-33
Attaché Case	C-104-1

Note: The calibration of the pull machines needs to be verified at least once a year, or sooner, if serviced or damaged. The L-30 Load Verification Unit shown on page 79 is available for this purpose.

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