

ZORN Laboratory Lightweight Deflectometer



Your US contact:

KSE Testing Equipment
17775 Running Colt Pl
Leesburg, VA. 20175

Phone 571-291-2284
Fax 571-291-2312
Mobile 571-246-3482
Virginia@kesslerdcp.com
www.kesslerdcp.com

ZORN Laboratory Lightweight Deflectometer

(Prototype)



Laboratory LWD testing on Proctor Mold
Determination of target modulus values for LWD field testing

HOCHPRÄZISIONS PRÜFTECHNIK



ZORN INSTRUMENTS GmbH & Co. KG • Benzstraße1 • 39576 Stendal (Germany)

Tel.: +49 3931 25273-0
Fax: + 49 3931 25273-10

www.zorn-instruments.com
info@zorn-instruments.com

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Introduction

The benefits of performance based quality assurance testing in road construction have become increasingly apparent. To a large part this can be credited to the wider use of LWDs (Lightweight Deflectometers) for measuring the elastic deformation of subgrade and subbase materials.

Over the past decade, ZORN INSTRUMENTS' Lightweight Deflectometer model ZFG has been the leading field test device for this application in the United States. An ASTM standard was established in 2011 (ASTM E2835 – 11[2015] - Standard Test Method for Measuring Deflections using a Portable Impulse Plate Load Test Device)

Public agencies as well as private consultants in a fast-growing number of US States have acquired ZFG Lightweight Deflectometers and have started to implement their use. Consequently, there is now a requirement to modify existing construction specifications and include LWDs as an option for road construction quality assurance.

Recently completed Transportation Pooled Fund Program Project #TPF-5(285) has

addressed this requirement. ZORN INSTRUMENTS now present a first laboratory device for use in LWD testing on Proctor Mold. This device is an adopted version of the known field test instrument. The proposed application is determination of target LWD modulus values in field through a laboratory procedure. As a prototype the ZORN Laboratory LWD reflects the findings and technical recommendations from the TPF project.

Your sincerely, Bernd Zorn (Mechanical Engineer, Germany)



Technical specifications

Assumed constants:

μ (Poisson's ratio)	0.5
f (shape factor)	2
g (acceleration, gravity)	9.81 m/s ²

ZORN Laboratory LWD parameters:

M =	17 kg (total mass)
l =	26.4" = 0.67 m (rod length)
m =	5 kg (falling weight)
h =	14.8" = 0.375 m (falling height)
k =	0.306 106 N/m (spring constant)
R =	3.0" = 75 mm (load plate radius)
F =	3.54 kN (collision force)
σ =	200 kPa (soil pressure)

Equations:

Dynamic elasticity modulus:

$$E_{vd} = f(1 - \nu^2) \cdot \frac{\sqrt{2mgkh}}{\pi R} \cdot \frac{1}{s}$$

Dynamic elasticity modulus (with device-specific parameters):

$$E_{vd} [\text{MN/m}^2] = \frac{22,5}{s[\text{mm}]}$$

Mount safety collar on Proctor mold rim

1



Place ZORN Laboratory LWD on compacted soil

2



Release transport lock

3



Latch falling weight at upper notch

4



Switch on electronic control box

5



Push start button and release falling weight

6



Results are instantly shown on control box display

7



1. Push print button and print test protocol

8



Before starting the LWD testing compact soil sample in a 6-inch mold to desired MC value (moisture content). Use standard compaction energy according to AASHTO T-99)

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