

Electrical Density Gauge

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Transportation Research Board
Meeting January 2008

Technology Methods

- Radio Frequency Measurements
 - 3 Mega-hertz (100 meter wave length)
- Dart Length and Spacing controls sample size
 - Easy to control and very definitive
 - e.g.: 6” dart at 14” spacing = 0.5 cu ft
- Onboard geo-electrical algorithms for moisture, density & compaction





EDG Field Use Procedures

MAKE A SOIL MODEL

Soil Models: 15

Test Spots per Soil Model: 3 to 20

Field creation of soil model

Lab creation of a soil model (EDG Proctor Mold using ASTM D 1557 or D 698)

ASSOCIATE A SOIL MODEL WITH A JOB SITE

Job Site memory capacity is: 15

CONDUCT FIELD TESTING

Field Tests per Job Site: 30

***ELECTRICAL PROPERTIES OF SOIL
AND GEOTECHNICAL ENGINEERING***

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Submitted To:

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Graduate Class
Special Problems 771

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The Electrical Density Gauge Technology For Soil Material Compaction And Soil Moisture Testing In Geotechnical Engineering

Measurements of the soil electrical parameters current (I_s), voltage (V_s), and phase (P_s) are made with circuitry that is well known in the field of electronic engineering, and implementation of these measurement means can take a variety of forms. The frequency source used in the EDG operates at 3.0 mHz.

From the electrical soil measurements, the software then calculates resistance (R_s) and capacitance (C_s), the quotient C_s/R_s , and real impedance (Z_s).

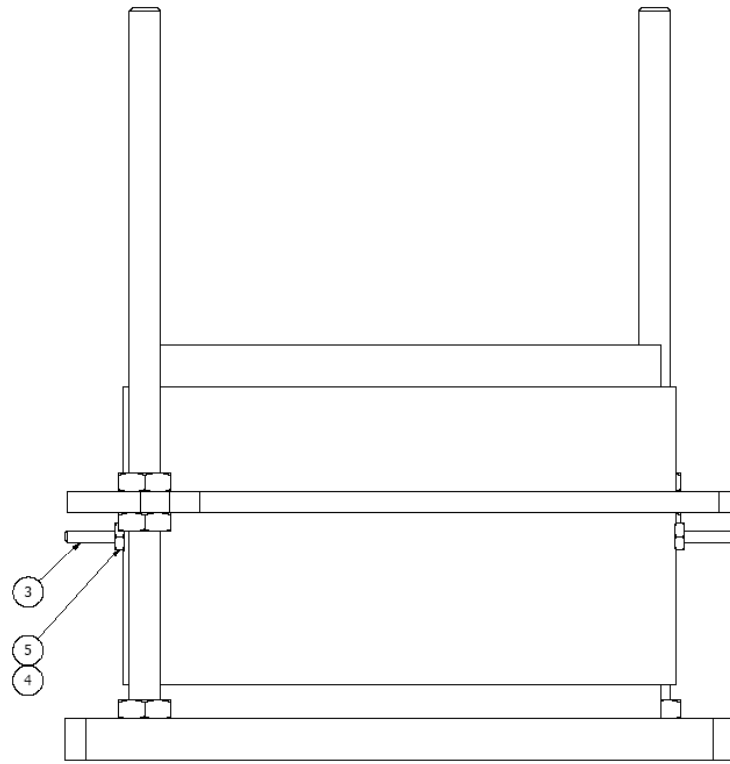
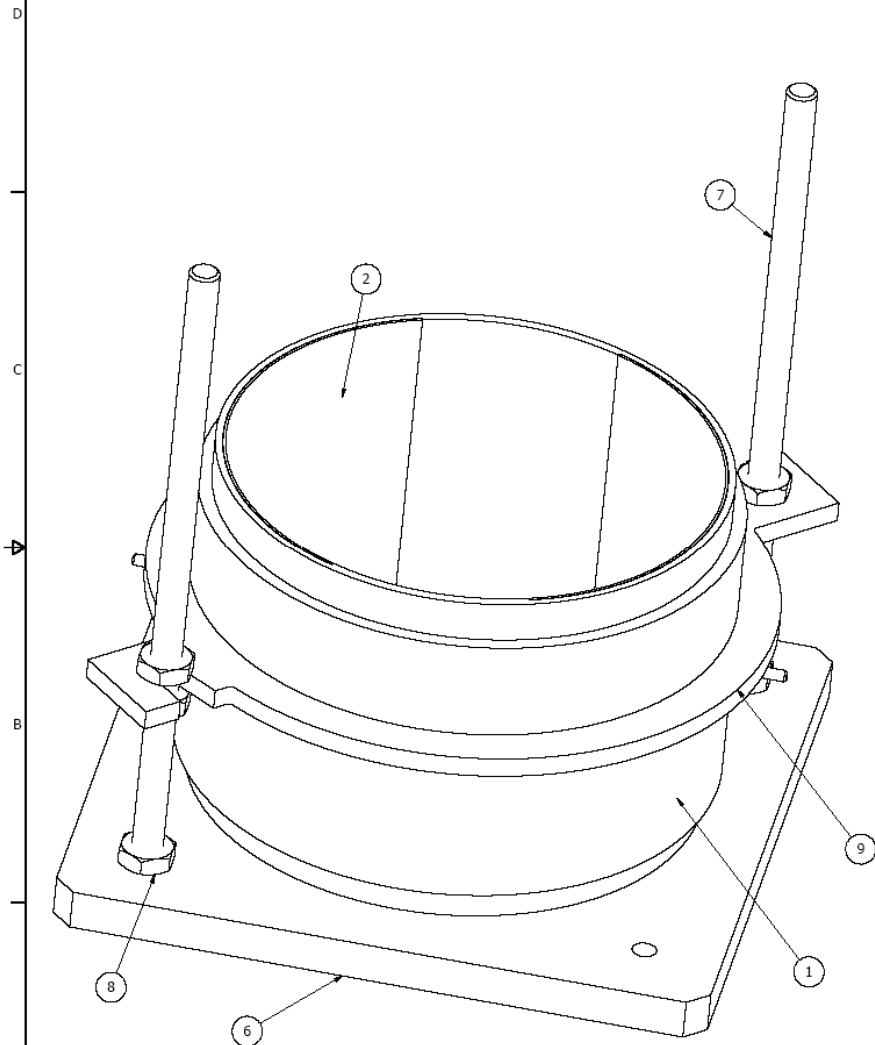
$C_s/R_s \rightarrow$ weight of water

And;


$Z \rightarrow$ wet density of the soil material.

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Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
9	1		PROCTOR MOLD SUPPORT RING
8	6		3/8-16 UNC HEX MACHINE SCREW NUT
7	2		3/8-16 UNC X 9" THREADED ROD
6	1	H-4151.1	BASE
5	2		6-32 UNC HEX MACHINE SCREW NUT
4	2		#6 INTERNAL TOOTH LOCK WASHER
3	2		6-32 UNC X 1" COUNTERSUNK FLAT HEAD SCREW
2	2		PROCTOR MOLD ELECTRODE
1	1		PROCTOR MOLD CYLINDER

DRAWN HAROLD R. CLARK 12/26/2007 RELEASED	 HUMBOLDT
MATERIAL H-4162	MODIFIED PROCTOR MOLD, SUBASSEMBLY
TOLERANCES UNLESS OTHERWISE SPECIFIED: .XX ± 0.030 INCHES .XXX ± 0.010 INCHES < ± 0.5	TITLE Proctor Mold Assy SIZE C SCALE FULL PART NO. SHEET 1 OF 1

Factory Mode Data Set from a Soil Model

SM003: Entry 005, 006, and 007

Oct. 5, 2004

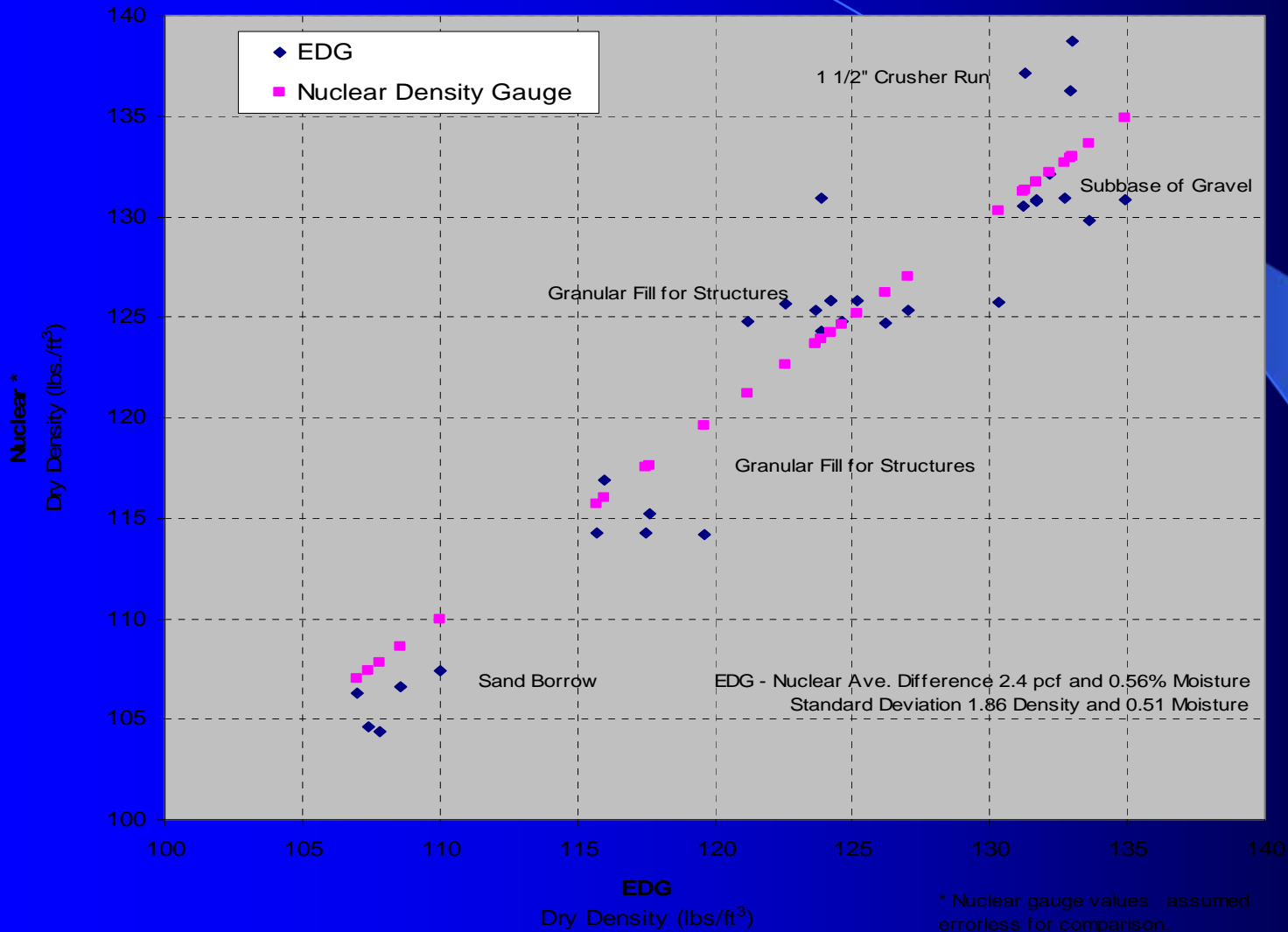
Test Data	Current	Voltage	Phase	Temp.	Res.	Cap.	Z	Wet Density	Dry Density	Percent Moisture	Max Dry Density
11:43:11A 10/05/2004 Tue SM003:005:001	0.677	2.056	-16.775	52.6	344.11	46.47	329.47	129.88	116.9	11.1	127.2
11:43:24A 10/05/2004 Tue SM003:005:002	0.694	2.039	-15.738	51.9	353.45	42.3	340.2				
11:43:38A 10/05/2004 Tue SM003:005:003	0.682	2.048	-15.775	52	346.14	43.3	333.11				
11:43:52A 10/05/2004 Tue SM003:005:004	0.676	2.05	-14.811	51.5	341.03	41.13	329.7				
11:56:26A 10/05/2004 Tue SM003:006:001	1.009	1.77	-25.441	55.7	631.2	39.98	569.99	126.49	116.9	8.2	127.2
11:56:40A 10/05/2004 Tue SM003:006:002	0.986	1.798	-27.175	55.7	616.15	44.2	548.14				
11:56:51A 10/05/2004 Tue SM003:006:003	0.993	1.79	-26.827	55.7	621.56	43.17	554.66				
11:57:06A 10/05/2004 Tue SM003:006:004	0.991	1.769	-25.949	55.7	622.86	41.45	560.06				
12:29:08P 10/05/2004 Tue SM003:007:001	0.831	1.913	-21.959	66.9	468.15	45.69	434.19	137.94	131.5	4.9	128.2
12:29:22P 10/05/2004 Tue SM003:007:002	0.818	1.926	-21.389	66.3	456.22	45.54	424.8				
12:29:34P 10/05/2004 Tue SM003:007:003	0.93	1.829	-23.552	65.9	554.54	41.7	508.35				
12:29:48P 10/05/2004 Tue SM003:007:004	0.859	1.889	-22.3	66.4	491.71	44.25	454.93				

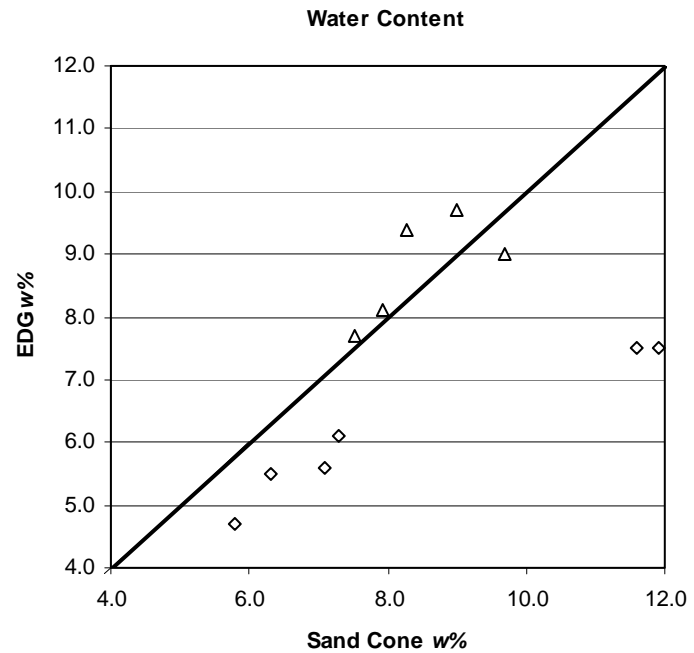
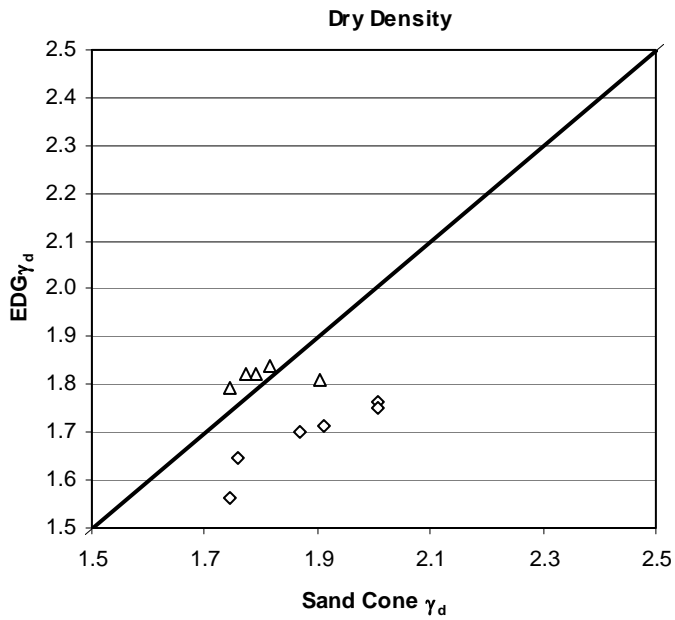
Operator Mode Data Download for Job Site JS 003, using Soil Model SM 004, Field Tests 1 through 9 on March 1, 2005

HyperTerminal 1.0 -- HyperTerminal data file
Please do not attempt to modify this file directly.

Serial #0005 (TC=ON)	Wet Density	Dry Density	% Moisture	% Compaction
11:43:11A 03/01/2005 Tue JS003:SM004:FT001	119.68	106.93	11.9	92.58
8:46:43A 03/04/2005 Fri JS003:SM004:FT002	111.78	104.11	7.4	90.14
9:11:10A 03/04/2005 Fri JS003:SM004:FT003	113.01	104.93	7.7	90.84
8:46:26A 03/07/2005 Mon JS003:SM004:FT004	117.76	105.68	11.4	91.5
11:18:08A 03/07/2005 Mon JS003:SM004:FT005	117.17	105.45	11.1	91.3
12:13:23P 03/08/2005 Tue JS003:SM004:FT006	119.52	105.89	12.9	91.68
10:55:06A 03/17/2005 Thu JS003:SM004:FT007	111.78	104.23	7.2	90.25
11:36:00A 03/17/2005 Thu JS003:SM004:FT008	112.76	105.02	7.4	90.93
10:45:00A 03/18/2005 Fri JS003:SM004:FT009	108.66	101.68	6.9	88.04

Vermont Agency of Transportation 2007 EDG v. Nuclear Density Gauge In Variable Aggregate Materials





University of Wisconsin 2005 Study on Silty Sand Material

Triangles represent sandcone data and diamonds represent nuclear gauge data.

EDG vs Sand Cone

Standard Deviation

Density = 0.75

Moisture = 1.85

EDG vs Nuclear

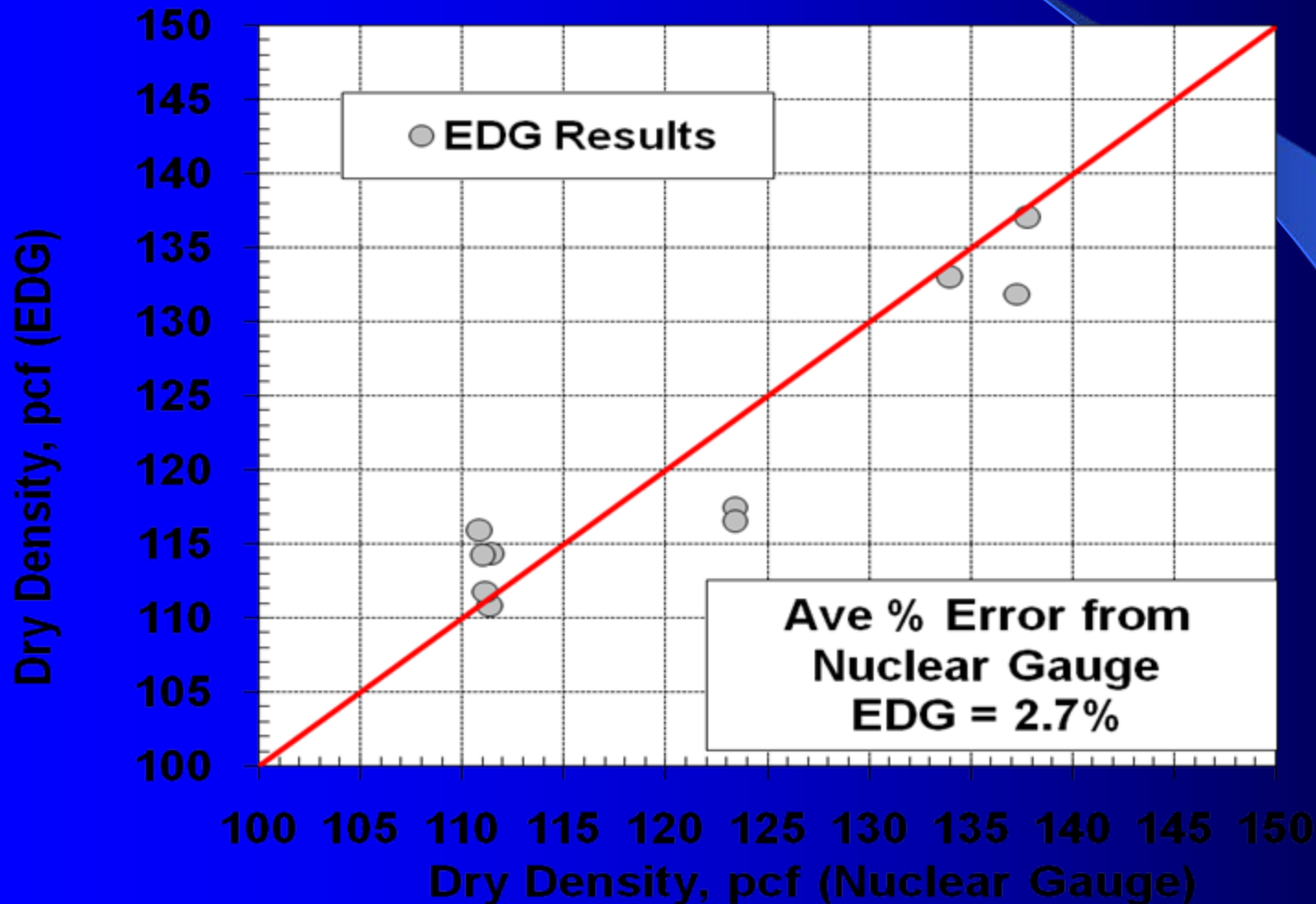
Standard Deviation

Density = 0.51

Moisture = 1.62

Rutgers University Summer 2007

Assessment Of The Moisture Density Indication For The Construction Quality Control Of Compacted Dense Graded Aggregate Base Layers



EDG Series C Scheduled Release for February 2008

Soil Model Upload And Download Capabilities

GPS Optional Feature

Windows Excel Easy Interface

Enhanced Data Entry And Data Management Features

Data Graphing Features and GPS Mapping Program

Model Sharing – Clearing House Program

EDG 2008 Research Projects

Louisiana State University & LDOT

Vermont Agency of Transportation

Idaho Department of Transportation

Nevada Department of Transportation Site Access

Venezuela Earth Dam Project

Possibly the US Coast Guard & Connecticut DOT

Possibly Alaska Department of Transportation

EDG Internal R & D Program

ASTM & AASHTO Standards Development

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