

Mini Great Dane

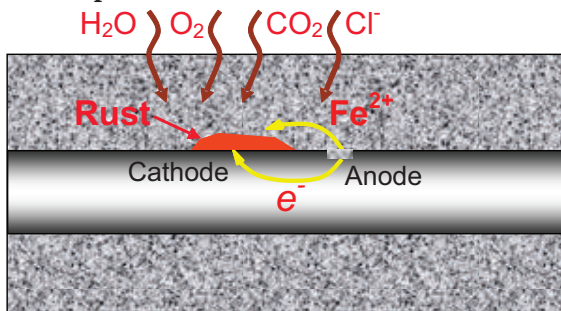
Purpose

The **Mini Great Dane** is used to measure the half-cell potential of uncoated reinforcing steel in concrete (in accordance with ASTM C876) and to measure the electrical resistance of the cover concrete. Typical applications include the following:



- Condition surveys of suspect reinforced concrete (RC) structures to identify areas with corrosion activity for further analysis (testing for chlorides, depth of carbonation, flaws, or permeation) to establish the cause of the corrosion and estimate remaining service life
- Monitoring RC structures for changes in corrosion activity
- Checking the effect of re-alkalization or electrochemical removal of chlorides
- Measuring the corrosion activity in repaired areas

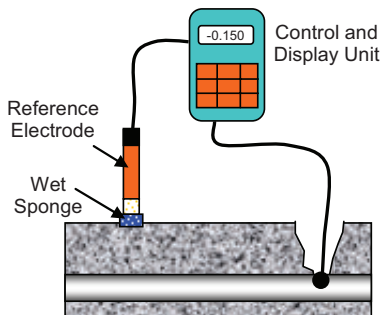
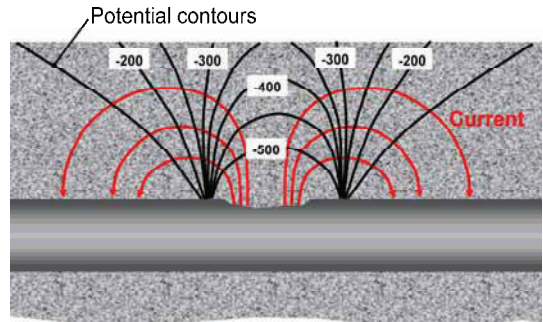
Principle



Reinforcement in concrete will not corrode if the protective film formed in the presence of highly alkaline pore fluid with a pH of about 13 is maintained. The passive layer may, however, be destroyed by the ingress of chloride ions or by a reduction in pH due to carbonation. When the passive film is destroyed, corrosion may occur in the presence of moisture and oxygen.

During the corrosion process, anodic and cathodic areas are formed on the reinforcement. At the anodes, iron dissolves and iron ions diffuse into the concrete, leaving behind electrons. At the cathodic sites, the iron ions combine with water and oxygen to form an expansive corrosion product, i.e., rust. The rate of corrosion is controlled by how easily the iron ions can move through the concrete from the anodes to the cathodes and it depends on the availability of oxygen and moisture at the cathodes.

The flow of iron ions through the concrete is associated with a potential field as shown on the right. The **Mini Great Dane** measures the surface potentials (relative to an Ag/AgCl reference electrode) and the electrical resistance of the cover concrete between the electrode and the reinforcement. The indicated potential, E_{corr} , is in terms of a Cu/CuSO₄ electrode (CSE), which are -110 mV lower in value than for the Ag/AgCl electrode. The risk of corrosion is evaluated by means of the steepness of the potential gradients measured at the concrete surface and the level of the electrical resistance of the cover concrete. A large potential gradient and a low concrete resistance will normally indicate a high corrosion rate, except in saturated concrete because of the low oxygen content.



| | Cover Condition | | |
|-----------------|------------------------------|------------------------------|-------------------------------|
| | Dry w/o Cl ⁻ ions | Wet w/o Cl ⁻ ions | Wet with Cl ⁻ ions |
| E_{corr} , mV | -50 to -200 | -250 to -350 | -400 to -600 |
| Gradient | | | |
| R, kOhm | 20 to 50 | 5 to 10 | 0 to 1 |

GI *Mini Great Dane*

After areas with the lowest potential, highest gradients, and lowest electrical resistance are identified, additional tests are performed to establish the cause of corrosion, e.g., testing for chlorides and carbonation. The concrete is removed at several “hot spots,” and the actual degree of corrosion is correlated to the readings. After identification of the cause of corrosion and establishment of the chloride ion profiles and depth of carbonation, the remaining service life may be estimated (e.g., using diffusion theory) or an appropriate repair strategy may be developed.

Variation

The variation of the potential readings with the Ag/AgCl measuring electrode supplied with the **Mini Great Dane** is normally within ± 5 mV. The electrical resistance variation is less than ± 5 %.

Testing Example

The access slabs of a housing complex had been subjected to de-icing salts for 18 years. No major rust stains or spalling were observed. Shown to the right are the electrical resistance and the potentials measured with the **Mini Great Dane** on one of the slabs. The relatively low electrical resistance towards the railings indicates a water saturated concrete and/or the presence of chlorides in the concrete. A large potential gradient is noted from the wall towards the railing. When the concrete was removed at several locations towards the railing, the bars were found to have heavy corrosion with a 1 to 20 % reduction of the cross section. Based on further testing with the **RCT** and the **Rainbow Indicator**, service life was estimated and a repair strategy was developed.

| kOhm | | | mV (CSE) | | |
|------|-----|----|----------|------|------|
| 72 | 55 | 5 | -50 | -110 | -390 |
| 70 | 64 | 5 | -40 | -120 | -125 |
| 68 | 60 | 5 | -30 | -100 | -135 |
| 71 | 65 | 8 | -45 | -120 | -120 |
| 64 | 62 | 14 | -50 | -90 | -110 |
| 59 | 55 | 10 | -45 | -95 | -380 |
| 81 | 49 | 19 | -50 | -110 | -390 |
| 73 | 59 | 20 | -45 | -110 | -380 |
| 78 | 54 | 15 | -60 | -125 | -365 |
| 82 | 68 | 27 | -55 | -135 | -405 |
| 89 | 74 | 19 | -45 | -100 | -355 |
| 98 | 72 | 21 | -50 | -90 | -325 |
| 92 | 87 | 35 | -60 | -85 | -310 |
| 99 | 90 | 44 | -50 | -75 | -115 |
| 102 | 103 | 65 | -55 | -70 | -65 |

Labels: Wall (left), Wall (right), Railing (left), Railing (right)

Line A, Line B, Line C (under each column)

The **Mini Great Dane-2000** Ordering Numbers

| Item | Order # |
|-----------------------------------|---------|
| Digital meter with signal box | GD-2001 |
| Ag/AgCl measuring cell | GD-2002 |
| Connecting cable | GD-2003 |
| Cable drum, 15 meters | GD-2004 |
| Reinforcement locator | GD-2005 |
| Drill bits, 10 mm and 18 mm | GD-2006 |
| Two reinforcement adaptors | GD-2007 |
| Allen key | GD-2008 |
| Two reinforcement clamping pliers | GD-2009 |
| Hammer and chisel | GD-2010 |
| Telescoping rod for Ag/AgCl cell | GD-2011 |
| Manual | GD-2012 |

Optional Items

| | |
|-----------------------|---------|
| Calibration cell | GD-2013 |
| Temperature probe | GD-2014 |
| Electric hammer drill | GD-2015 |
| Garden spray pump | GD-2016 |



GERMANN INSTRUMENTS A/S

Emdrupvej 102, DK-2400 Copenhagen, Denmark

Phone: +45 39 67 71 17, Fax +45 39 67 31 67

E-mail: germann-eu@germann.org Web site: www.germann.org



GERMANN INSTRUMENTS, Inc.

8845 Forest View Road, Evanston, Illinois 60203, USA

Phone: (847) 329-9999, Fax: (847) 329-8888

E-mail: germann@germann.org Web Site: www.germann.org



Test smart - Build right