# Zero Resistance Ammeter

Model ZM3 for Field Applications



## Accurate

As public scrutiny toward pipeline integrity grows, regulators are frequently requesting that operators validate corrosion prevention data to prove that their assets are protected from failure. This means that in many situations, legacy measurement techniques are no longer sufficient and there is a need for validation to avoid ambiguity.

This need for validation led to the development of Corrosion Service's CPMP IR Free DC Coupon and the ZM3 Zero Resistance Ammeter. Used together, these tools provide a highly accurate indication of current flow to the pipeline that corresponds to corrosion protection levels and validates the basic surface measurements typically gathered during pipeline surveys.

## Measurement

The amount of current between the pipeline and the validation coupon is typically very small and measurement tools require micro amp resolution. Conventional ammeters are inadequate for reading small currents since the loading effect of the meter adds an error value to the reading. The ZRA overcomes this loading effect and provides an extremely precise and accurate indication of protective current.

## Features & Benefits

+ Reduces ambiguity by providing validation of corrosion protection data.
+ Confirmation of actual parameters compared to design values.
+ Automatic operation, with little specialized training required.
+ Rugged lightweight construction for field use.
+ Stable over an external operating temperature range of -10°C to +50°C (14°F to 122°F).
+ Extended measurement and temperature ranges available upon request.



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## Technical Data

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|---|---|
| **Range** | 0–2 mA and 0–20 mA |
| **Resolution** | 0.1 µA on 2mA scale 1.0 µA on 20mA scale |
| **Accuracy** | Better than 0.5% over entire range |
| **Dimensions** | 300 x 250 x 120 mm (11.8 x 9.8 x 4.7 Inches) |
| **Weight** | 1675 g (3.7 lbs.) |

## Description

The Corrosion Service Zero Resistance Ammeter is an industry leading field micro amp meter, specifically designed for the corrosion industry.

## Characteristics

- Designed for use with DC Coupons

### EXAMPLES OF DATA INTERPRETATION AND CALCULATIONS

#### Measurement of Coupon DC Current

The coupon has been connected to the pipeline long enough to stabilize in the environment. This connection is temporarily removed and quickly replaced with a connection via a Zero Resistance Ammeter (ZRA), with the "+" CURRENT INPUT connected to the coupon and the "-" CURRENT INPUT connected to the pipe. The current measured between the 10 $cm^2$ coupon and the pipe using the ZRA is +100 µA, with the current returning to the pipeline.

Since the measured DC current is a positive value (i.e., current is returning to the pipe), this shows the coupon is receiving cathodic protection. As the coupon had stabilized, a similar coating defect on the pipeline at this location would be subject to a similar current density. Even if the coupon had not yet stabilized, the positive current would provide a useful indication about cathodic protection levels.

The DC current density is the ratio between the current and the surface area of the coupon, see below for calculation. There is no current density criterion for full cathodic protection because it depends on the soil conditions, but 10-30 $mA/m^2$ is a helpful rule of thumb for full cathodic protection and even a smaller positive current would indicate a reduction in corrosion rate.

$$\text{Current Density} = \frac{\text{Current}}{\text{Coupon Area}} = \frac{100\ \mu A}{10\ cm^2} = \frac{100\ \text{x}\ 10^{-3} mA}{10\ \text{x}\ 10^{-4} m^2} = 100\ mA/m^2$$

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Canada / USA / Global

corrosionservice.com
+1 (800) 676-4984
materials@corrosionservice.com