

# Ferrite Meter MF300Fm+

**DIVERSE**

Measure Ferrite Content of Austenitic & Duplex Steel

www.diverse-technologies.net



## Features

- Non-destructive test of the ferrite content in a range of 0.1 to 115 FN equivalent to 0.1 to 80.5% Fe in austenitic and duplex steel.
- Robust and portable
- Standard or peak measurement of Ferrite Number
- Estimate of ferrite percentage (using a FN to F% curve)
- Automatic zero on demand
- Choice of probes: 10mm diameter probe or 4x6 mm probe, up to 5 probes per instrument
- Sprung loaded sleeve (4 mm x 6 mm probe)
- Supplied with 5 transfer standards allowing veracity of instrument to be checked
- Storage of 1000 measurements including 4 character record ID, downloaded to PC with RS232/USB (option)
- Use with high temperature samples (air-cooled probe option - 10 mm diameter probe)
- Simple measurement with small sample area.
- Units selectable between WRC-FN and %Fe.
- Calibration with standards traceable to World Secondary Standards
- Supplied in carry case

## Overview

Industrial processing and chemical plants work at high temperatures and pressures, often with aggressive media and stainless steel is often the material of choice for these applications. If the ferrite content of the steel is too low, then welding of stainless material may crack at elevated temperature or with high stress or vibration. Alternatively, if the ferrite content is too high, the weld may be weaker and corrode.

To address the need to measure the amount of ferrite in a sample the Welding Research Council introduced the Ferrite Number (FN) as a standardised value which related to the ferrite content of an equivalently magnetic weld metal.

The volume percentage of ferrite can be estimated as about 70% of the FN but the relationship depends upon the type and origin of the stainless steel used and the measurement technique. The MF300Fm+ uses a transfer curve to convert measured FN to F%.

The Diverse Ferrite meter MF300Fm+ measures the Ferrite number (FN) of austenitic and duplex stainless steel weld material. It has a probe that is sensitive to ferrite content in a 80 mm<sup>2</sup> area to a depth of approximately 1 mm. Alternatively there is a small area probe with a sensitive area of 24 mm<sup>2</sup> (4 mm x 6 mm)

The instrument is calibrated using the secondary world standards validated by National Institute of Standards and Technology (NIST) in the USA. All 16 standards are used in the calibration giving an instrument with a measurement range from 0 to 115 FN. Transfer standards are supplied with the instrument allowing performance to be verified at any time.

The latest Ferrite meter MF300Fm+ interrogates the probe type plugged into the instrument. And recalls the calibration data for that probe. There are 5 probe options: P10, P10AC, P46, P10-2, P46-2 (second probe options).

A variety of measurement modes are supported to ensure that good repeatable measurements can be made.



**MF300Fm+ : Performance Specification**

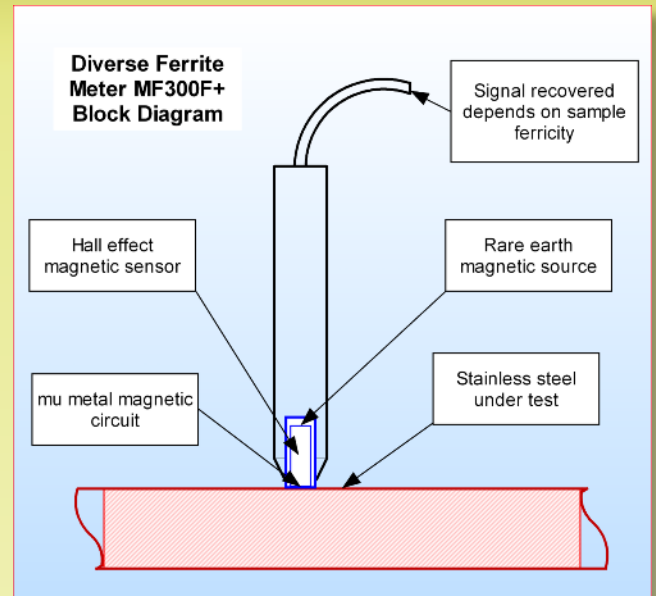
Units	Ferrite Number FN Ferrite percentage F%
Range	0 - 115 FN 0 - 80.5% (percent ferrite)
Resolution	0.1 FN 0.1 F%
Standard: Accuracy (10°C - 30°C) FN 0 - 10 FN 10 - 30 FN 30 - 100	± 0.5 FN ± 5% of the reading ± 10% of the reading
Air cooled: Accuracy (30°C - 300°C) FN 0 - 10 FN 10 - 30 FN 30 - 100	± 1 FN ± 10% of the reading ± 20% of the reading
Calibration	Factory calibration to NIST standards User calibration to supplied transfer standards Up to 5 calibrations can be supplied (for 5 probes)
Transfer standards	Five transfer standards Range typically 3 FN to 115 FN
Zero	Automatic on demand
Mode	Average or peak
Storage	1000 records with 4 character records ID (characters available 0-9, A-Z and space)
PC Download and Upload	Optional RS232 and USB Functions include download of record or part or entire database and upload of record IDs
Probe P46	Pencil style, 15 mm diameter length 130 mm Sensing area 4 mm x 6 mm (24 mm <sup>2</sup> ) Sprung loaded sleeve
Probe P10	Pencil style, 15 mm diameter length 120 mm Sensing area 10 mm diameter (~80 mm <sup>2</sup> )
Operating temperature	Standard 0°C - 40°C (P46 and P10) Air cooled 0°C - 300°C (P10ac)
Air cooled operation	Air line supply regulated to 1 bar maximum Oil filtered supply desirable Air temperature: ambient (10°C - 30°C)
Humidity	Non-condensing
Weight in case	1.25 kg
Case dimensions	210 x 100 x 45 mm
Support	Call/email Diverse for support for use of the instrument or assistance with unusual application.

## Operation

The MF300Fm+ uses a static magnetic field technique to determine the degree of ferricity. A rare earth magnet is introduced into a complex mu metal magnetic circuit such that the introduction of ferritic material at the tip of the probe modifies the field distribution in the probe.

The change in the magnetic field is detected using a state of the art Hall effect magnetic sensor. The signal from this sensor is processed by the instrument to produce a reading. The calibration of the different readings is matched to the known ferrite numbers of the Secondary World Standards.

A key advantage of the technique over other ac excitation methods is that there is no error due to ac skin effect or extraneous ac induction.



## Ferrite Number

Ferrite number is a measure of Chromium and Nickel equivalent in an Austenitic stainless steel material and is a measure for denoting the ferrite content in stainless steel. It should be between 3-7% maximum because very low ferrite can lead to cracks. Ferrite Number has been adopted as a relative measure for quantifying ferritic content using magnetic techniques. The Ferrite Number approach was developed in order to reduce the large variation in ferrite levels determined on a given specimen when measured using different techniques in different laboratories.



The ferrite level is important to assure minimum exposure to solidification cracking when depositing austenitic stainless steel weld metal. A lower ferrite number is better for corrosion resistance, while balancing higher ferrite content to avoid solidification cracking in the weld

deposit. Low ferrite numbers are less important for applications such as cladding where no cracking is observed. Testing for ferrite number can be achieved using the MF300Fm+ and crack testing can be done using liquid penetration verification.



## About the MF300Fm+

MF300Fm+ is the latest instrument in the popular range of magnetic meters from Diverse and includes extended record storage. The robust slimline probes benefit from a novel magnetic design with excellent coupling to the measurement sample. This results in sensitivity to a small well defined volume and excellent response over the full range of ferrite samples.

An air-cooled version of the 10 mm diameter probe (this must be specified at time of order) allows Ferrite measurement of hot samples.

The latest software supports calibration over the whole range of secondary ferrite samples prepared by NIST. Transfer samples are supplied with a range of FN allowing user calibration and verification of the main calibration.

Storage of up to 1000 measurements is included. Communication with a PC, via RS232 or USB, is provided as an option, including downloading of records or all or part of the database and upload of record IDs. The record structure includes record number (0-999), measured ferrite number and record ID (4 characters, valid characters 0-9, A-Z and space).

## Calibration/World Standards

The Diverse MF300Fm+ is calibrated using standards that are traceable to internationally accepted secondary standards. The International Institute of Welding in the UK (IIW) developed secondary standards that have been tested by NIST and The Welding Institute,(TWI) according to methods described in DIN EN ISO 8249 and ANSI/AWS A4.2.

The master calibration of the instrument is made against these standards. The transfer calibration standards supplied with the MF300Fm+ are simulations of the magnetic effect of ferrite number and are each calibrated for this effect against the IIW standards.

## Probes

The Diverse MF300Fm+ is supplied with a choice of pencil-like probes with an internal precision magnetic circuit and sensor.

### Large area (P10, P10ac)

The large area probe is constructed with a 10mm diameter ring that is set proud at the tip. For measurement, this ring is brought into contact with a reasonably flat portion of the object under test and a reading can be taken. This has the advantages of averaging over a wide area removing any need for statistical analysis.



With an air flow adaptor and other internal and calibration changes, the air cooled probe version allows for measuring of hot samples. Air flow is directed in the standard hose connector, over the sensor and magnetic components and is routed out of vent holes in the probe barrel.



### Small area (P46)

The small area probe (4 x 6 mm) retains the pencil style but senses over a much reduced area. It can be used to measure weld seams down to 4 mm width. It has a sprung loaded sleeve to minimise probe tip wear. The probe has the advantage of small sensing area suitable for welds and pipes. The end of the probe should be flat against the sample under test.



## Items supplied

Diverse MF300Fm+ Ferrite Meter and probe or probes  
5 x Transfer standards  
Carry case

### Probes (interchangeable up to 5)

4 mm x 6 mm probe MF300Fm+ P46  
10 mm probe MF300Fm+ P10  
10 mm probe with air cooling MF300Fm+ P10ac

### Option:

Serial/USB cable and software MF300+ser