

ABB MEASUREMENT & ANALYTICS

# Pressure filtration melt cleanliness analyzer

Prefil®-Footprinter



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## **Measurement made easy**

**Prefil-Footprinter is the only inclusion analyzer that provides an immediate result and, at the same time, a sample for further metallographic analysis.**

**These two qualities make the Prefil-Footprinter a powerful solution for performing process control on a day-to-day basis, and/or on a more in-depth audit basis for process optimization. The Prefil-Footprinter is simple to use and designed to survive the foundry floor.**

# Prefil-Footer

## A quick and thorough inclusion control solution

### 01 Prefil-Footer operation steps

Today's global economy and competition have compelled aluminum producers and foundries to produce the highest quality aluminum and shape castings. Process expertise is essential to ensure world class quality. On-line process monitoring enables melt quality management at all stages of the manufacturing process.

- On-line inclusion measurement
- Process control and optimization
- Residue for metallographic analysis
- Low cost per measurement with reusable crucibles

The Prefil-Footer's rugged construction is based on an open architecture that will give you access to improvements and upgrades over the long life expectancy of the instrument. The instrument is well engineered for process optimization and routine measurement by shop floor personnel.

### Prefil-Footer operation principle

The flow-rate of molten metal through a micro filter at constant temperature and pressure is monitored and used to plot a graph of weight filtered vs. time. Inclusions in the metal, such as oxide films and small particles, quickly build up on the filter surface during a test, reducing the flow-rate through the filter. The slope and overall shape of the weight filtered vs. time curve indicate the level of inclusions present in the metal. Regular Prefil testing and reference to a suitable production "window" allows the metal quality to be monitored and remedial action to be taken if quality drops. In addition to

the filtration curve, metallographic analysis of the residue that is retained on the filter after a Prefil test allows identification and quantification of the types of inclusions present in the metal sample. Once the inclusion profile of a product line has been characterized, it is easier to select the most appropriate monitoring and control procedures for maintaining consistency. A Prefil test is easily performed in three steps as shown below.

#### Step 1

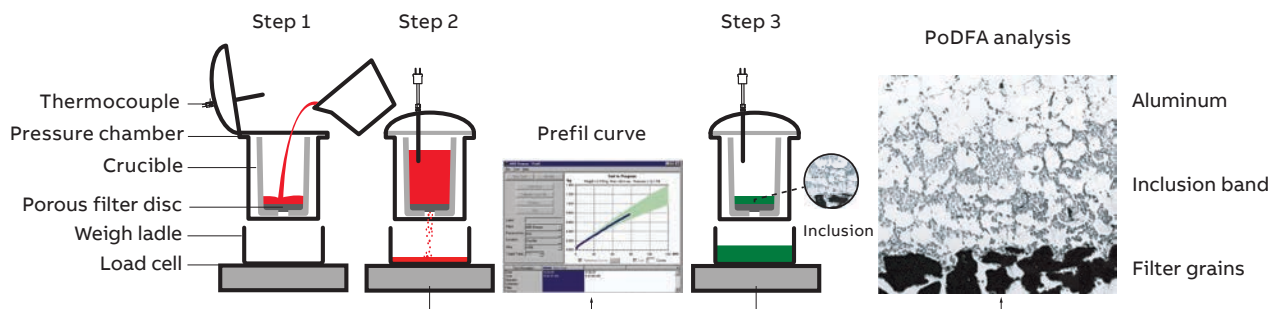
A reusable crucible, with a filter previously installed in the bottom, is first pre-heated and installed in a pressure chamber. The operator then takes a sample of liquid metal with a ladle, pours it into the crucible and closes the lid.

#### Step 2

When the metal temperature drops down to the specified target value for the test, the system applies a constant pressure in the chamber, forcing the metal to flow through the porous filter disc. A load cell connected to a computer records the weight of filtered metal as a function of time. The filtration curve is displayed in real time on the computer screen.

#### Step 3

The test is completed in less than 3 minutes and the pressure chamber is automatically de-pressurized. The test result is saved with relevant information and used to easily generate a comprehensive report. The metal residue is identified and kept for future metallographic analysis.





01 Prefil Footprinter analyzer

02 Prefil characteristics and the industrial footprint graph

03 6xxx footprint graph

04 Prefil metrics control chart

## Prefil Footprints

The real power of Prefil is only realized when the Prefil curve for a particular molten metal sample, obtained on-line, is compared to a pre-established 'window' or 'footprint' for an appropriate level of quality.

Since molten metal quality often changes as it flows through the metal and delivery systems, footprints maybe required for samples taken at different stages during the casting process. Prefil footprints are used when evaluating Prefil curves for samples taken from the final stage of the process, immediately prior to casting, e.g., DC head launder, dip well, pouring spout, etc.

A356 premium automotive casting alloy:

- Prefil is the ideal tool for monitoring and optimizing both manual and rotary fluxing practices.
- Prefil can tell you if your fluxing practice is efficient and how to optimize residence time.

Prefil can also tell you:

- The molten metal quality from melting and holding furnaces and at any point during the process.
- The levels of residual (possibly ineffective) grain refiner particles.
- The effect of metallurgical additions, such as eutectic modifiers and grain refiners, on metal quality.

AA60XX general quality extrusions – grain refined:

- Prefil is used to optimize in-line metal treatment systems such as rotary degassers and filters.
- Prefil can be used to correlate molten metal quality with parameters such as extrusion die life (number of billets per die). This knowledge is critical to process cost modeling.
- Prefil is sensitive to grain refiner particulate ( $\text{TiB}_2$ ,  $\text{TiC}$ ) and can highlight deviations in standard practice when they arise.

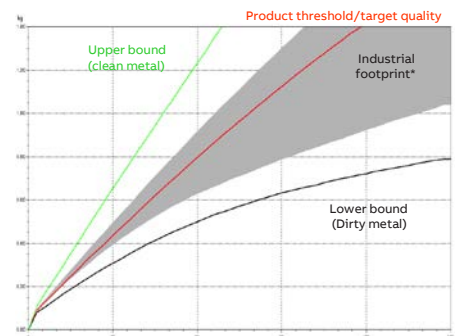
## ABB PoDFA metallographic analysis service

You do the sampling; we take care of the analysis. Use a PoDFA-f system to take samples quickly and easily. Identify each metal residue indicating the sampling information, and send all samples by express mail to our PoDFA metallographic analysis service. You will receive a report with key residue pictures and a breakdown of each inclusion type expressed in  $\text{mm}^2/\text{kg}$  of aluminum.



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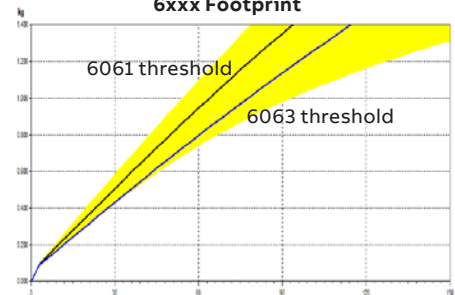
## Prefil characteristics and the industrial footprint



\* The industrial footprint is the metal quality range defined by the average of all data for a particular alloy or product in the N-Tec database ( $\pm$ ) one standard deviation. This means that 66 % of all industrial data lies inside the shaded area.

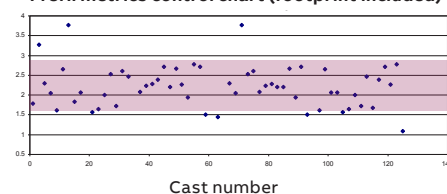
02

## 6xxx Footprint



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## Prefil metrics control chart (footprint included)



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- 01 Metallographic analysis
- 02 ABB metallographic analysis service
- 03 Reusable crucible
- 04 Reusable crucible trolley for safe cooling and easy saw carrying
- 05 Metal sample holder

### Prefil Metrics

A feature is available in the Prefil software called Prefil Metrics. This add-on automatically calculates two new parameters from the Prefil curve:

- The primary slope of the curve
- The area under the curve

These metrics can be plotted separately on a control chart or grouped to correlate with metallographic measurements of oxide film and total inclusion content (PoDFA values).

### In-depth metallographic analysis for inclusion types and concentrations

In addition to the filtration curve, metallographic analysis of the Prefil residue allows identification and quantification of the types of inclusions present in the metal sample. The build-up of inclusions at the filter surface during a Prefil test creates an inclusion band, which can be quantitatively analyzed using optical microscopy. By today's standard, it is widely acknowledged that a filtration technique can identify and quantify inclusions.

### ABB metallographic analysis service

ABB has a metallographic analysis laboratory highly specialized in inclusion identification and counting. We do a large number of analyses every year for our customers all over the world. Simply identify and mail your Prefil samples to ABB. You will receive a report with key residue pictures and a breakdown of each inclusion type expressed in mm<sup>2</sup>/kg of aluminum. All information is strictly confidential and reports are produced in less than two weeks. There is no license fee: you pay on a per-sample basis.

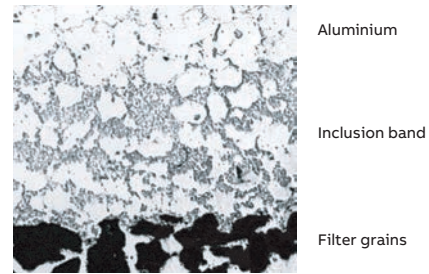
### Reusable crucibles and filters

The reusable crucible is designed to better meet the needs of foundries and cast houses by decreasing operational costs. Prefil users truly benefit from this innovative approach because it reduces risk of damage during handling and shipping (robust design).

The patented reusable crucible can last for approximately 100 samples. Prior to each test, a ready-to-use filter is easily installed in the crucible in a matter of seconds. Thanks to this leading-edge design, the filter detachment problem has been almost eliminated as the filter is literally cast into the aluminum.

### Filter on ceramic disk

We now offer filters mounted on a ceramic disk. They can reduce preheating time by 10 minutes and the use of an expandable material as gasket greatly reduces the risk of leak when pouring molten metal into the crucible.



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# Specifications

## Measurements

Mass: up to 6 kg  $\pm$  0.02 kg (up to 13.2 lb).

**Important:** Mass above 9 kg (20 lb) can damage the load cell.  
Reproducibility: Overall margin on the Prefil-Footer printer curve is  $\pm$ 9 % at a level of confidence of 95 % (two sigma) at any time during the filtration.

## Software operating system

Windows 10 (x86 or x64)

## Hardware

Thermocouple: Type K, ungrounded

## Supplies

### Compressed Air

Inlet port: 4 to 8 bar (58 to 116 psig)

Maximum pressure: 10 bar (145 psig)

Air consumption: 566 l/min (20 SCFM) maximum, at 6.9 bar (100 psig), inlet pressure and the cooling valve fully opened.

Purity: dry and clean (filtered to 40  $\mu$ m)

Maximum air temperature: 40 °C (104 °F)

## Electrical

Rated voltage: 100 to 240 V AC

Rated input current: 10 to 5 A

Frequency: 50/60 Hz

## Environmental

Operating temperature: 0 to 50 °C (32 to 122 °F) ambient

Operating humidity: up to 95 %, non-condensing at ambient temperature of 40 °C (104 °F); up to 85 %, non-condensing at ambient temperature of 50 °C (122 °F)

## Physical

Overall dimensions (H  $\times$  W  $\times$  D):

56.0  $\times$  71.0  $\times$  112.5 cm (22.0  $\times$  28.0  $\times$  44.3 in)

Weight: 103 kg (227 lb)

## Reusable crucible

### General

Heating time, on heater: 30 min (typical)

**Important:** Typical times are based on crucible and heater at normal room temperature, no forced convection around the equipment and the use of an insulation blanket over the crucible.

## Crucible lifetime

Up to 100 tests when following the proper preparation and manipulation procedure described in the user's guide

## Crucible protective coating

Needs to be redone every 15 to 20 tests

**Important:** Crucible lifetime is dependent on the protective coating. Carefully follow the procedure described in the user's guide.

## Physical

### Crucible

Outside diameter: 13.3 cm (5 ¼ in)

Height: 20.3 cm (8 in)

Weight: 1.36 kg (3 lb)

Materials:

- Outer shell: carbon steel, aluminum and silica
- Inner shell: stainless steel
- Insulation: synthetic vitreous fiber (SVF) blanket

## Packaging information

3 crucibles per box, 24 filters per box

## Environmental

Storage temperature range:

–10 to 75 °C (14 to 167 °F)

Storage humidity range: Up to 60 %, non-condensing

## Crucible heater

Heating time: 0 to 6 hours (adjustable timer)

## Electrical requirements

Rated input voltage: 100 to 120/220 to 240 V AC (factory set)

Rated input frequency: 50/60 Hz

Earth leakage: Less than 50 mA

Rated input current: 4 A at 230 V AC, 7 A at 115 V AC

Fuse type: T4A/250 V at 230 V AC, T7A/250 V at 110 V AC

## Environmental

Operating temperature: 10 to 50 °C (50 to 122 °F)

Storage temperature: 10 to 75 °C (14 to 167 °F)

Operating humidity: up to 90 %, non-condensing

Storage humidity: up to 60 %, non-condensing

## Physical

Overall dimensions (H  $\times$  W  $\times$  D):

35  $\times$  29  $\times$  21 cm (13 ½  $\times$  11 ½  $\times$  8 ¼ in)

Weight: 5.6 kg (12 lb)

## Acknowledgments

Prefil® is a registered trademark of N-Tec Limited.  
Windows® is a registered trademark of Microsoft Corporation.







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