

Preface:

Each FC ¹⁾, independent from the type of press, will be tested according to the same test procedure. The FOGRA institute in Munich and the MPA (Staatliche Materialprüfungsanstalt) in Darmstadt are approved by the workshop "Corrosion on Printing Presses" to perform the required test. Members of this workshop are Heidelberger Druckmaschinen AG, MAN ROLAND AG and KBA AG.

Classification of printing presses

Depending from the type of the press different corrosion limits are to be applied. The printing presses are classified as follows:

- sheetfed offset presses, in the following description termed sheetfed (offset).
- web offset presses with continuous feed dampening system (usually heat-set web offset), in the following description termed heatset (offset).
- for web offset presses with turbo,- brush,- spray,- or centrifugal dampening system (usually cold-set or semicommercial web offset), in the following description termed coldset (offset).

1. Preconditions of the standard test

a) Limits for pH and electrical conductivity of the ready to use fountain solution

- Stabilisation of the pH value in the range of $5,0 \pm 0,2$ to $9,0 \pm 0,2$.
- The conductivity of the fresh fountain solution is limited to $1500 \mu\text{S}/\text{cm}$ (for Heatset and Coldset presses) and $1700 \mu\text{S}/\text{cm}$ (for Sheetfed presses) above the conductivity of the water which is used to prepare it.

b) Limits for corrosive ions in the ready to use fountain solution

Halogenides esp. Chlorides and bromides	< 25 mg/l
Sulfates	< 50 mg/l
Nitrates	< 20 mg/l

The concentration of these ions can be determined by ion chromatography.

c) Test water, experimental conditions, test cell, calibration

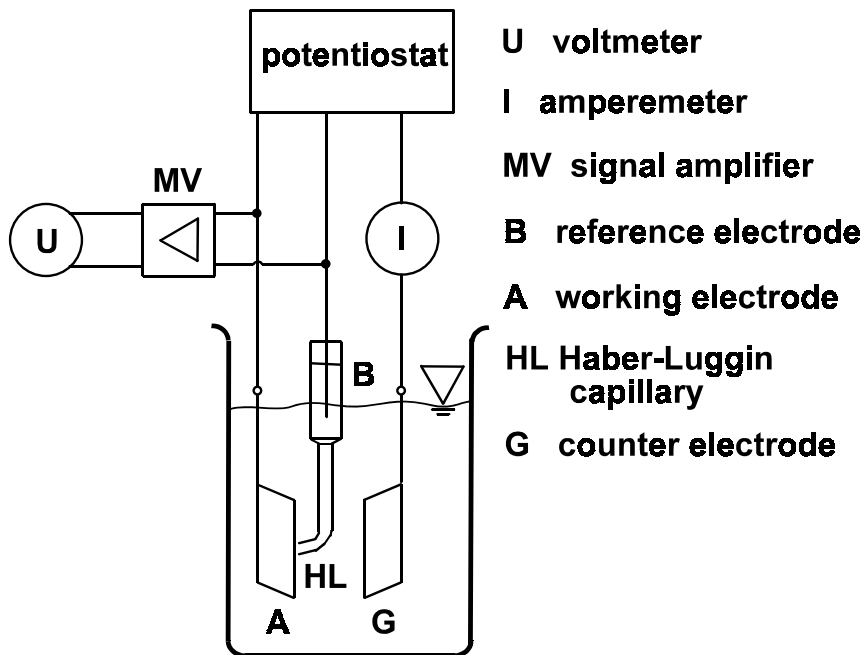
The FCsolution is prepared by dissolving the maximum applied concentration of the concentrate (3 %, for instance) in test water with a hardness of 10 °dH ("Deutsche Härte", i.e. Ca and Mg) containing the following anions: 25 mg/l chloride, 50 mg/l of sulphate and 20 mg/l of nitrate.

The electrochemical examination with outer current source (polarisation) must be carried out at a controlled temperature of 40° C (104 ° F), the fountain solution is unstirred and not aerated.

The test procedure is described in the following scheme (E. Heitz, R. Henkhaus, A. Rahmel, Korrosionskunde im Experiment, VCH 1990, Weinheim, York, Basel, Cambridge - ISBN 3-527-28156-8, p. 27)

¹ FC = Fountain Concentrate

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To avoid measurement faults and misinterpretations it is recommended that the measurement cell should be calibrated prior to the examinations.

The calibration of the cell (see figure) is performed with rolled nickel of 99.7 % purity, LC-Quality (Material No. 2.4060 according to German standard DIN 17740/17750) in H_2SO_4 of p. A. quality at a molarity of 0.05.

The calibration is made as described at 2.1.1 and 2.1.2. The result of the calibration must be documented. Deviations of the calibration curve are tolerable as far as ± 10 % of the maximum current and ± 50 mV of the potential of the current maximum and of the passivation potential will not be exceeded.

2. Test procedure for pure nickel and roller bearing steel

2.1 Nickel resistance test

2.1.1 Determination of the open circuit potential E_{corr} against a rolled nickel sheet ² during a period of 15 min.

2.1.2 Recording of the anodic current/potential curve starting at the open circuit potential minus 10 mV with a polarisation rate of + 1000 mV/h up to a potential of + 1200 mV_{SHE} ³). If a specific current density of 20 $\mu\text{A}/\text{cm}^2$ is achieved before + 700 mV_{SHE} the FC will not pass the test.

If a specific current density of 10 $\mu\text{A}/\text{cm}^2$ is not exceeded before a potential $\geq + 700$ mV_{SHE}, the FC has passed the test.

2.1.4 In case of activity of the material at the open circuit potential, the current density should not exceed the limit of 20 $\mu\text{A}/\text{cm}^2$

²) Material number 2.4060, purity 99.7%, LC-quality, German standard DIN 17740/17750 sheet thickness 2 mm cold rolled, annealed, pickled.

Manufacturer Krupp VDM, supplier Hempel, Oberhausen.

³) Potential values with the index 'SHE' are relative to the standard hydrogen electrode (SHE)

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before passivation. If the current density is higher than $10 \mu\text{A}/\text{cm}^2$ but does not exceed $20 \mu\text{A}/\text{cm}^2$ an additional immersion test according to German standard DIN 50905 has to be performed. This test lasts 168 h. During this immersion test the fountain solution must be replaced every 24 hours (five times) by fresh fountain solution.
The limits for the specific weight loss rate are:

Mass loss rate Δm [mg/(cm ² * 7d)]	Heatset presses	Coldset presses with spray, brush or turbo dampening units	Sheetfed presses
Nickel (99.6 %; VdEh 2.4060)	4 mg/(cm ² * 7d)	3 mg/(cm ² * 7d)	15 mg/(cm ² * 7d)

In all cases pitting corrosion will not be tolerated.

2.2. Mild steel resistance test with the low alloyed cold work steel 100 Cr6 GKZ (annealed for spherical carbides), German standard No. DIN 1.3505 according to DIN 17230

An immersion test according to German standard DIN 50905 will be performed. This test is shortened to 168 h. During this test the fountain solution must be replaced every 24 hours (five times) by fresh fountain solution (according to pt. 2.1.4.)

The specific mass loss rates (see below) must not be exceeded.
Electrochemical tests on mild steel are not performed

The limits for the mass loss rate are:

Mass loss rate Δm [mg/cm ² * 7 d]	Heatset presses	Coldset presses with spray, brush or turbo dampening units	Sheetfed presses
Steel 100 Cr 6; mat no. 1.3505)	20 mg/(cm ² * 7 d)	15 mg/(cm ² * 7 d)	25 mg/(cm ² * 7 d)

For coldset and heatset founts local corrosion at the coupons will not be tolerated.

2.3 Determination of the risk of pitting corrosion of stainless steels

An electrochemical pitting plot on steel X 20 Cr 13, material-No. 1.4021 according to standard DIN EN 10088-3, heat treatment condition QT 800, which has to be grinded freshly straight before the test is performed.

The fountain solution concentrate passes the test in the case that

The fountain solution concentrate passes the test, if

1. A current density of $10 \mu\text{A}/\text{cm}^2$ is not exceeded to a potential value of $E_{\text{Redox.}} + 250 \text{ mV}$.

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2. The current-density plot does not show a pitting potential at a potential value of less than 1200 mV_{SHE} (**Fehler! Verweisquelle konnte nicht gefunden werden.**, curve a).
3. The current-potential plot shows a pitting potential at a potential value of less than +1200 mV_{SHE} and the values of the pitting potential and the potential of repassivation are larger than the redox potential + 250 mV (**Fehler! Verweisquelle konnte nicht gefunden werden.**, curve b).

The fountain solution concentrate fails the test, if

1. A current density of 10 µA/cm² is exceeded to a potential value of E_{Redox.} + 250 mV.
2. The current-potential plot shows a pitting potential at a potential value of less than +1200 mV_H and the potential of the repassivation is smaller than the redox potential + 250 mV (**Fehler! Verweisquelle konnte nicht gefunden werden.**, curve c).

2.4 Examination of the presence of redox systems and easily oxidizable components in the FC

If a FC exceeds the maximum current density of 20 µA/cm² (see 2.1.2) and therefore fails the test, it will be necessary to examine whether the actual shape of the current-potential curve was not caused by a redox system or easily oxidizable components. The following test must be performed:

- 2.4.1 Determination of the redox potential by using the platinum counter electrode as the working electrode.
- 2.4.2 Recording of the open circuit potential of platinum during a span of 15 min.
- 2.4.3 Recording of the anodic current/potential curve starting at the open circuit potential minus 10 mV with a polarisation rate of + 1000 mV/h up to a potential of + 1200 mV_{SHE}.

Before running the tests 2.5.1 and 2.5.2 the client should be contacted and agree to the further tests.

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3. General instructions

A detailed testing scheme is also available.

All instructions on the specimen dimensions, the pretreatment of the coupons, the preparation of the test water, experimental procedure etc. are described in the detailed testing scheme.

The testing scheme serves mainly press OEM's for FC approvals. An approval of an FC is achieved when the OEM confirms that the test results carried out by an independent institute are doubtless within the specifications of the testing scheme. An institute can be entitled by the OEM 's to approve FC 's directly.

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