Court case of a coupling flange of cast iron

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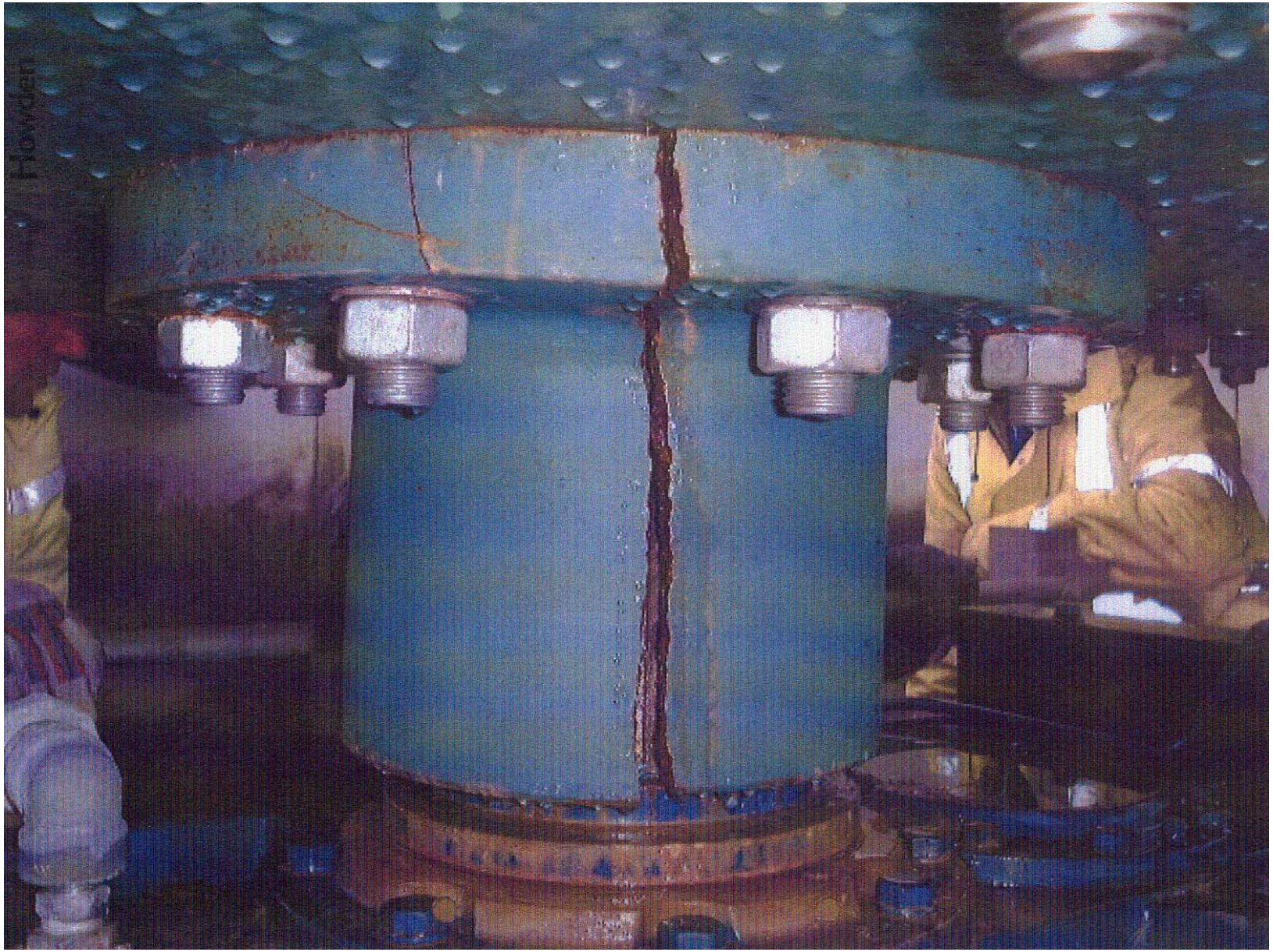
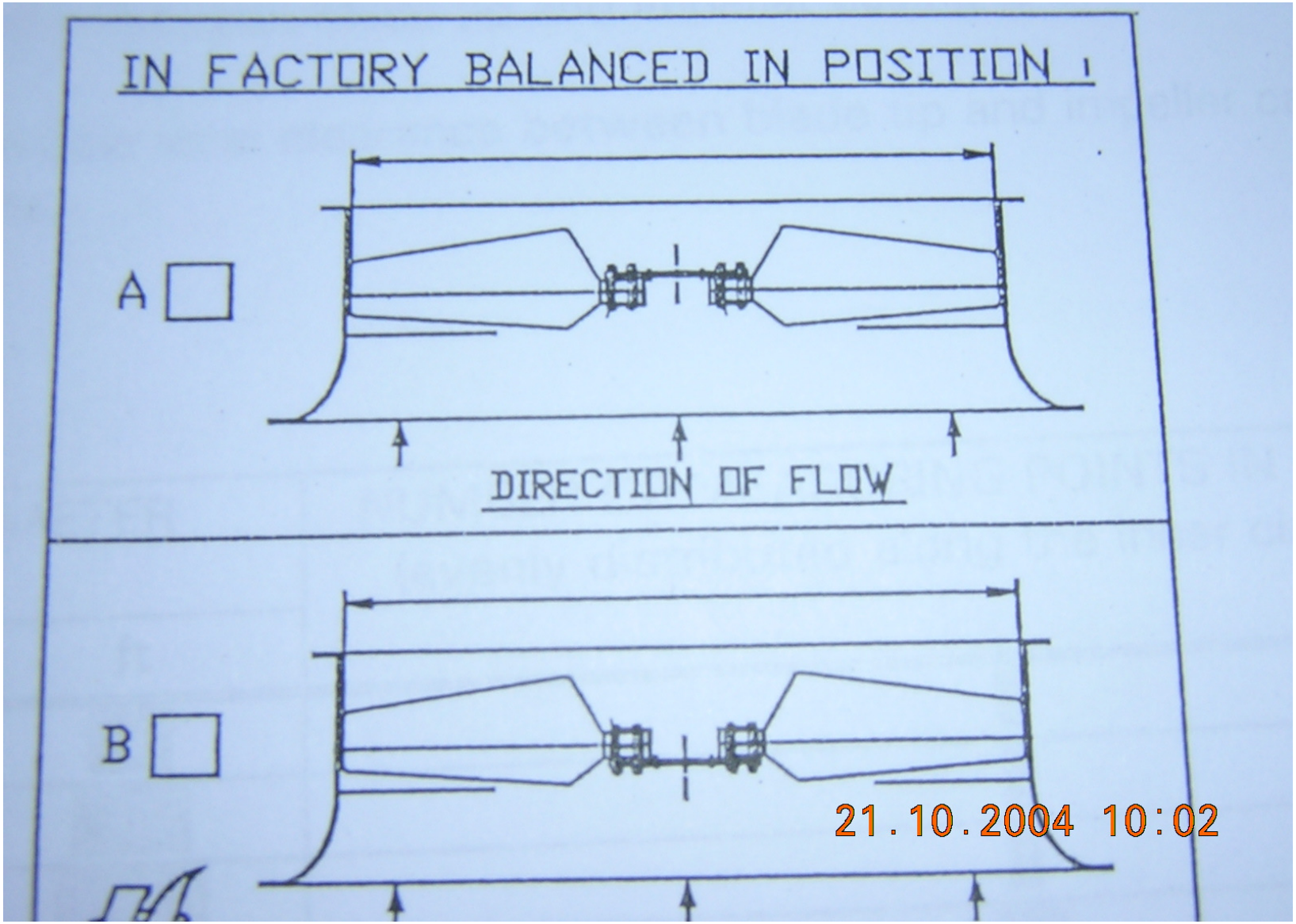
Law suits

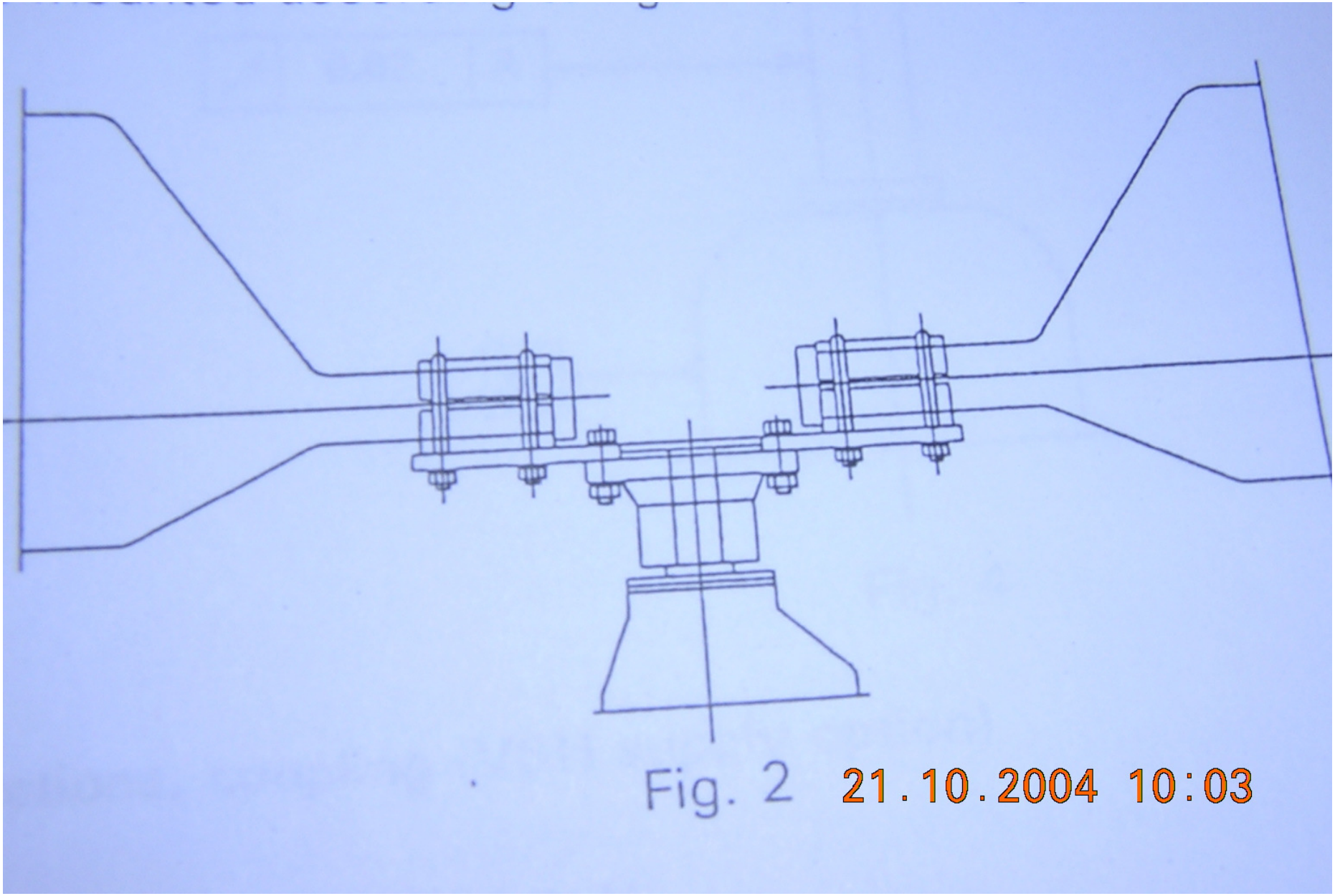
- Law suits about technical subjects are ***long lasting***.
- Law suits start with investigations with ***company experts***.
- When parties mutually not agree an ***expert witness*** from court will be appointed**.**
- The court poses a ***restricted number of specific questions*** to the expert.
- The expert witness ***proposes a plan and a budget***.
- Only after both parties have agreed the judge makes a verdict
- After the ***fee has been paid*** the expert can start.



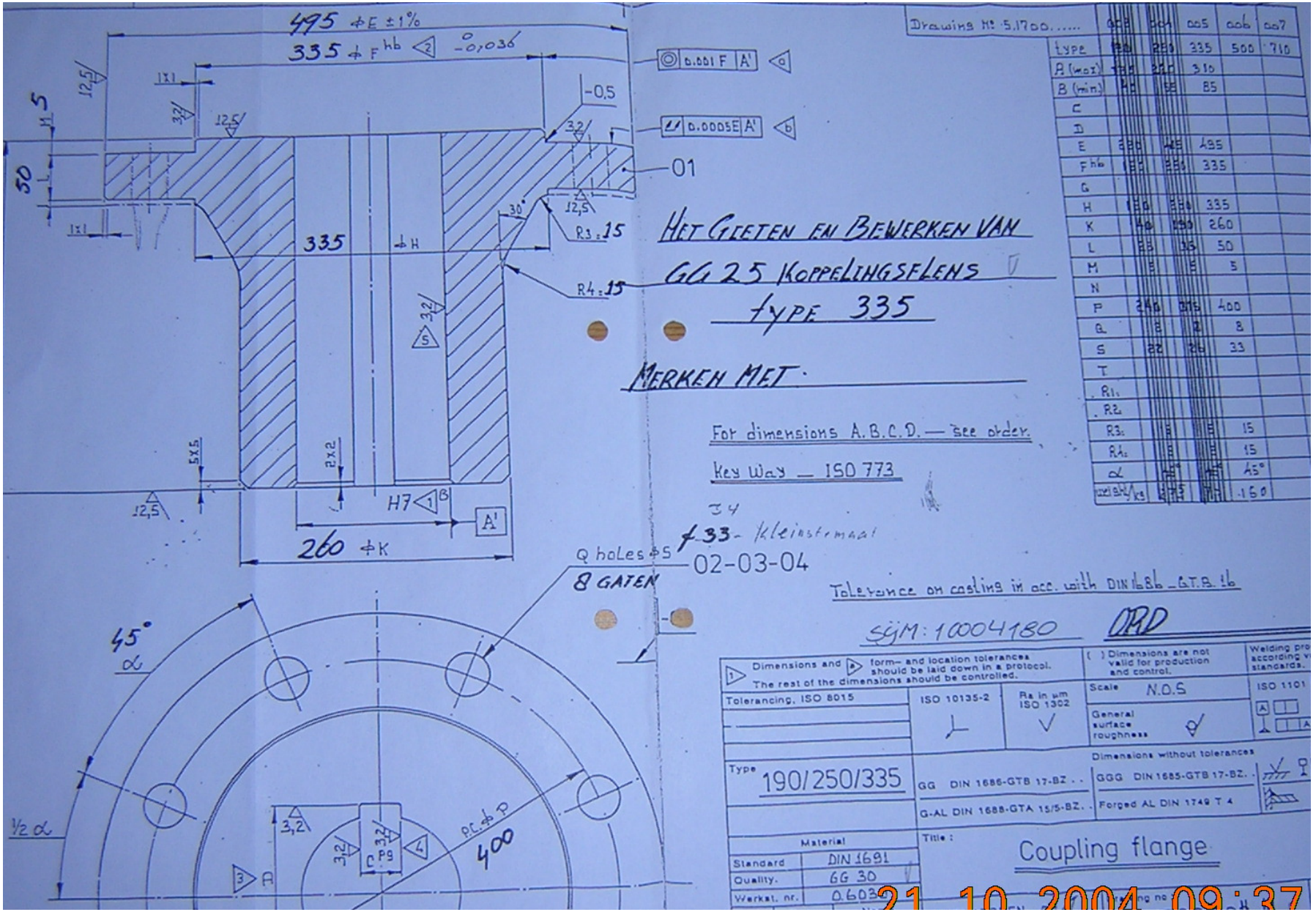
Ruptured coupling flange



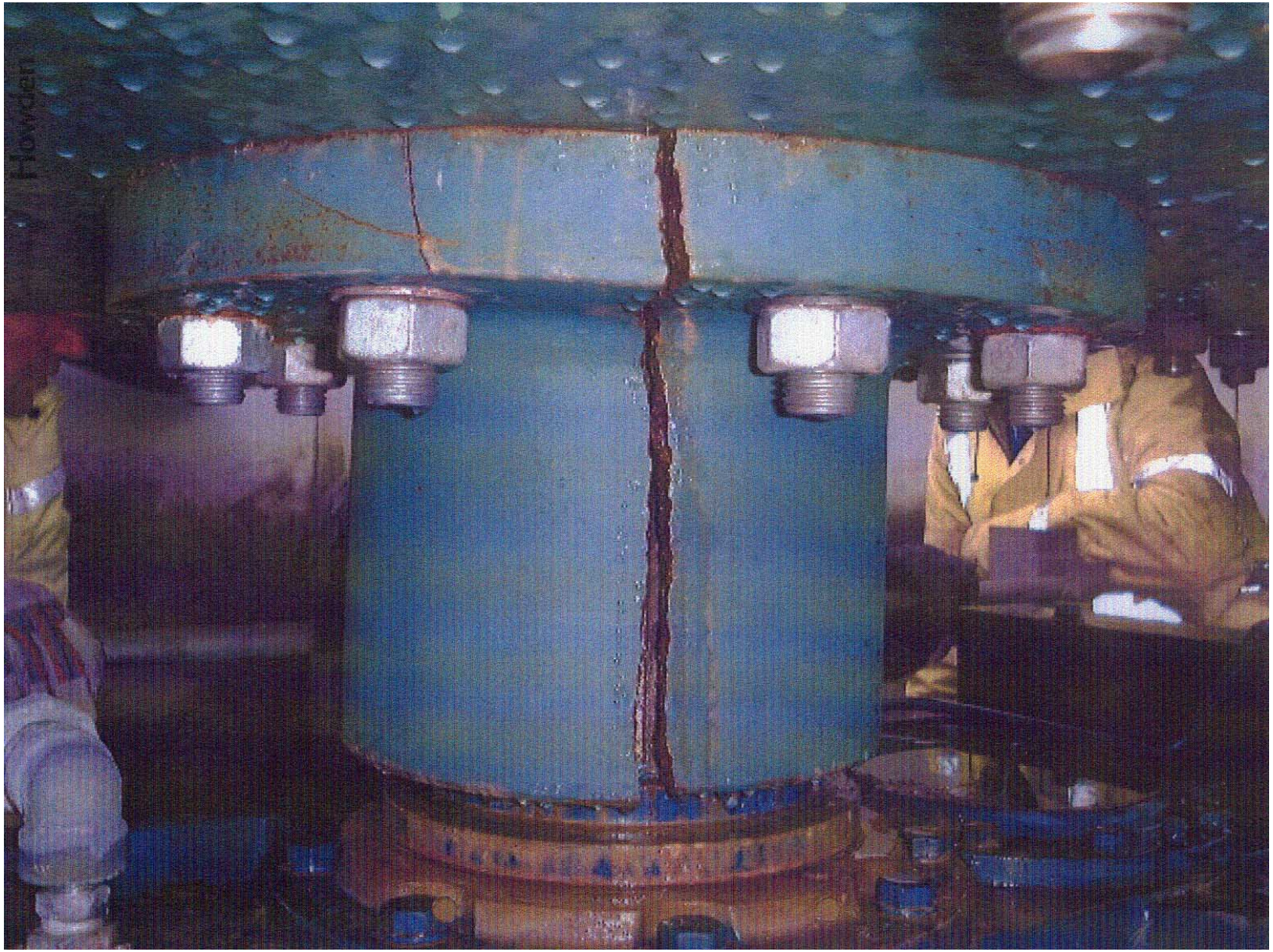
Cooling fan in cooling tower



Coupling with blades

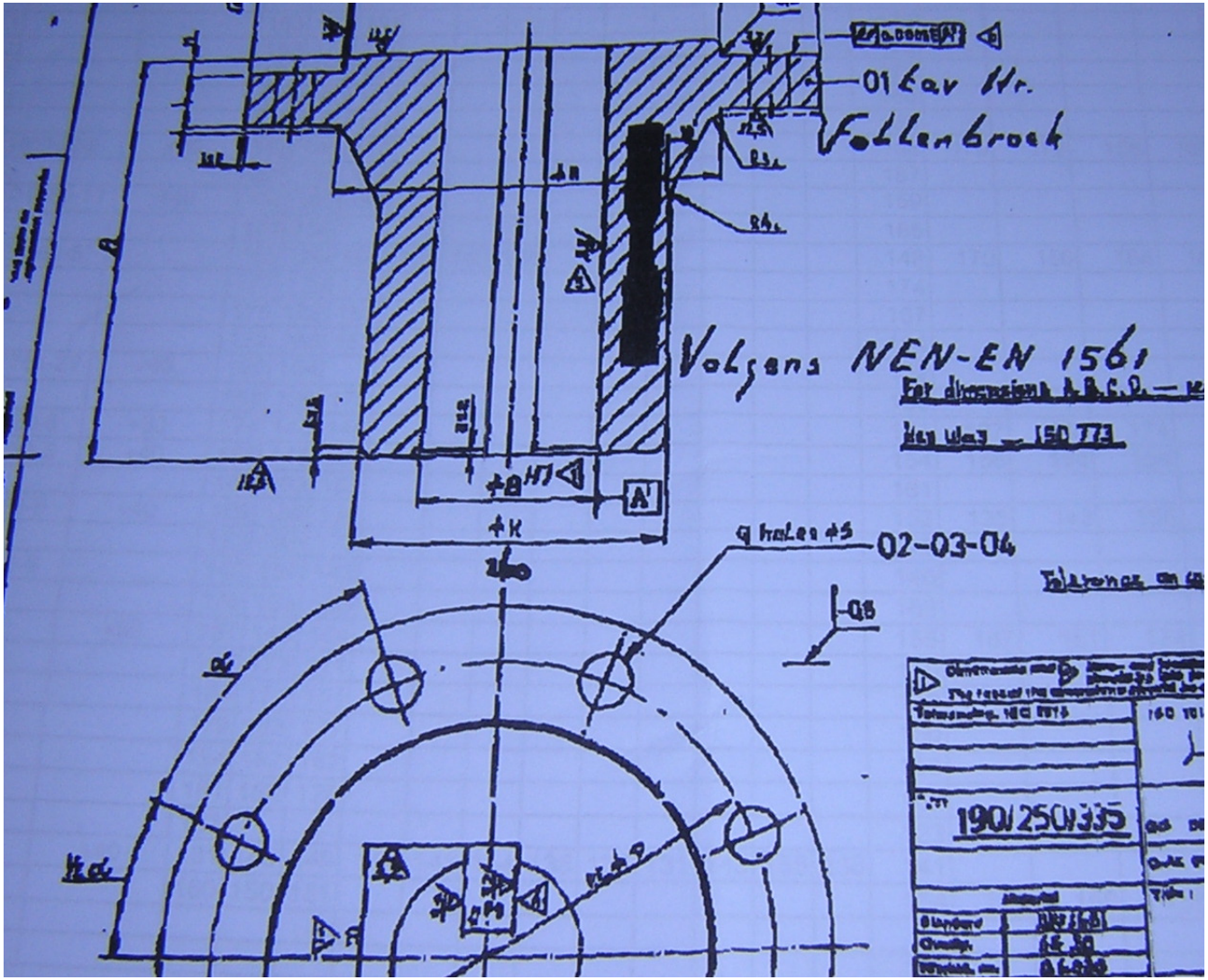


Drawing of the coupling flange



Ruptured coupling flange

Photographs of couplings at Stork FDO (VHS)



Location of the specimens

Coupling with a sliced part has been removed for manufacturing tensile specimens

History

- **Moulder supplied** coupling flanges (machined mouldings of cast iron GG25 of GG30) to Howden Cooling Fans (HCF)
- The **moulder supplied** 30 couplings to HCF in the **middle of 1999** .
- **HCF** supplied the ventilators to **Balcke Dürr**.
- **Balcke Dürr** installed the ventilators in a cooling tower during summer **2000.**
- The cooling towers are part of power generation plant **in Fifoots Wales**. Main contractor is **General Electric.**
- During testing in **August 2000** 1 coupling broke down: fans and cooling tower have been severely damaged. (no inspection report)
- HCF starts a legal procedure against moulder in **November 2000**
- 3 other couplings had flaws during inspection in **December 2000.**
- Both parties order investigations.
- **December 2003** verdict of the judge about the appointment of an expert witness.
- July **2004** 1st expert witness report (microstructure is degenerated)
- **November - 2004** Trial in court.
- Opposition from the moulder (14 pages of comments)
- Final comparison in court (degeneration of microstructure is admitted)

Investigations:

- **Study of the dossier.**
- Study of reports from institutes
- Specific information (Internet).
- Photographs.
- Visit to WTMC (moulder)
- Visit to Stork FDO (VSH)
- Discussion of the report with the specialist in the field of cast iron

Dossier with mainly nonsense and very bad photographs

Investigations:

- Study of the dossier.
- **Study of reports from research institutes**
- Specific information (Internet).
- Photographs.
- Gesprekken met partijen.
- Visit to WTMC (moulder)
- Visit to Stork FDO (VSH)
- Discussion of the report with the specialist in the field of cast iron

Study of reports from institutes

STORK FDO for Howden Cooling Fans

Investigations into the properties of cast iron coupling flanges

Correlation between microstructure and tensile tests.

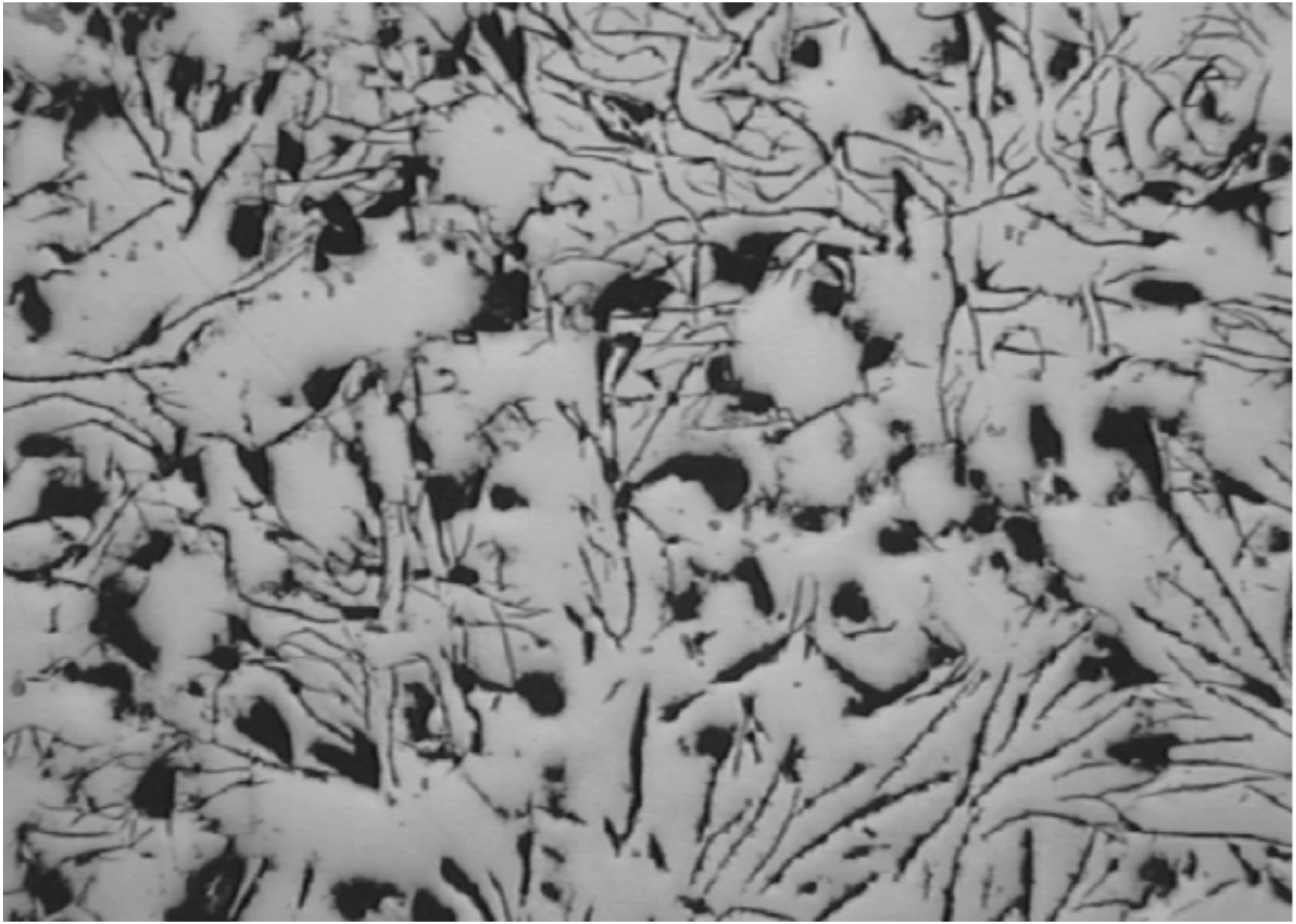
WTMC for the moulder.

Some remarks about the microstructure

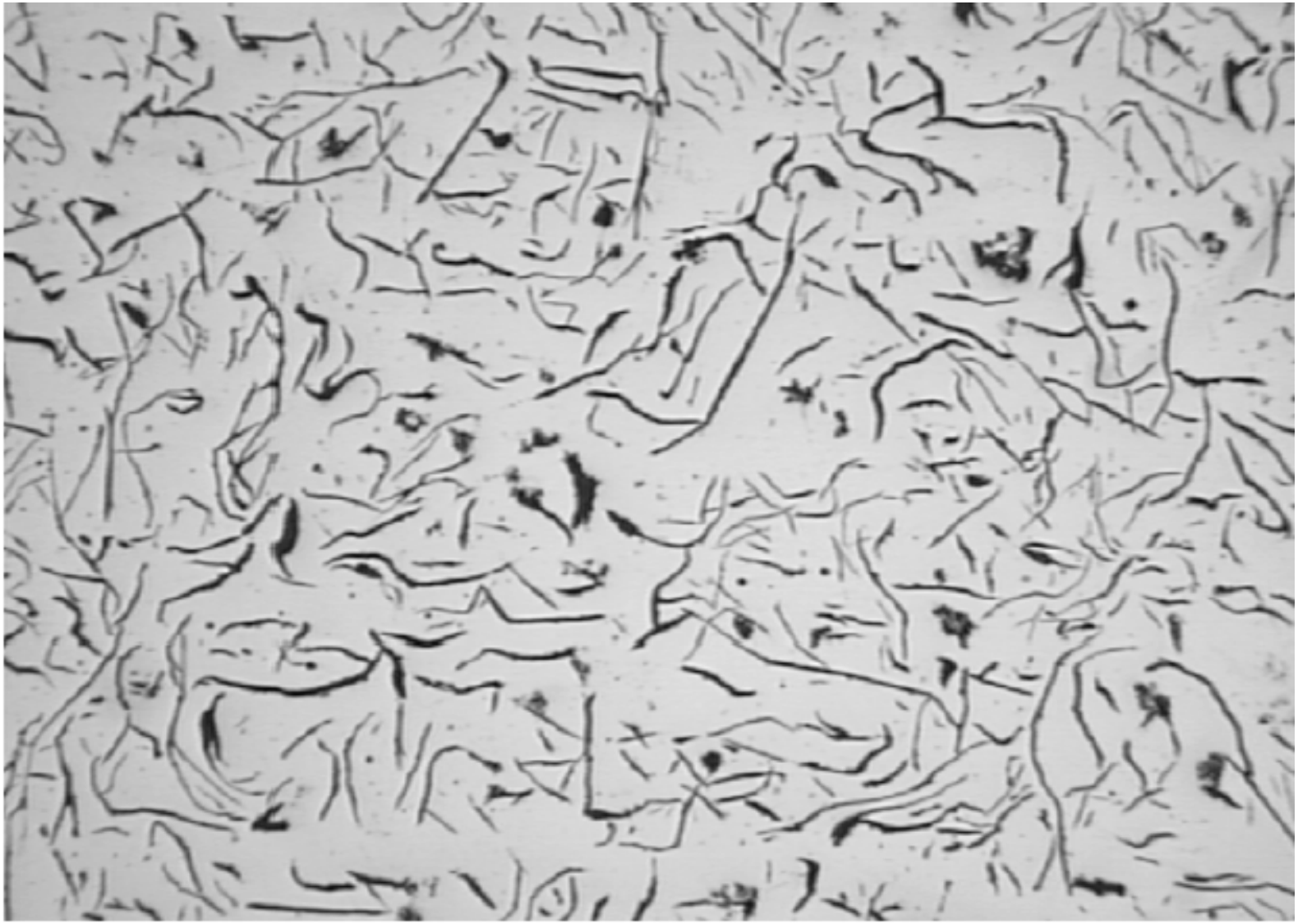
law suit coupling flanges

nr	N/mm^2	N/mm^2	N/mm^2		HB	HB	HB
6	148				170	172	156
8	164				165	170	156
10	76	98	88		170	156	164
14	156	178	177		150	140	153
16	182				187	184	174
17	156				156	145	145
19	143	184	195		135	143	156
21	97	99	92		138	133	135
23	147				167	161	174
29	245				187	184	180
30	98				161	156	156

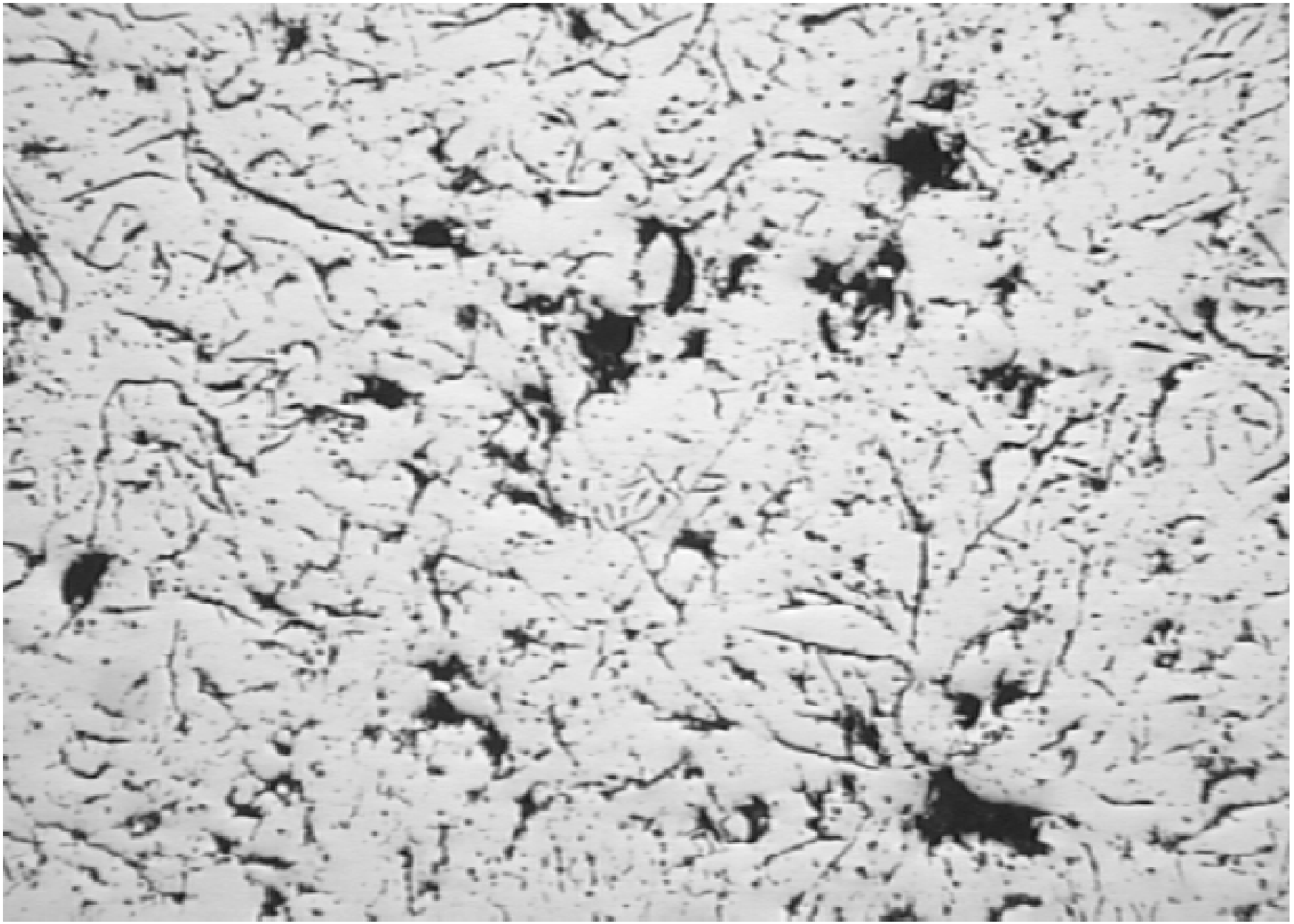
Microstructure of a good flange



Microstructure of a bad flange



Microstructure of another good flange



Microstructure of another bad flange

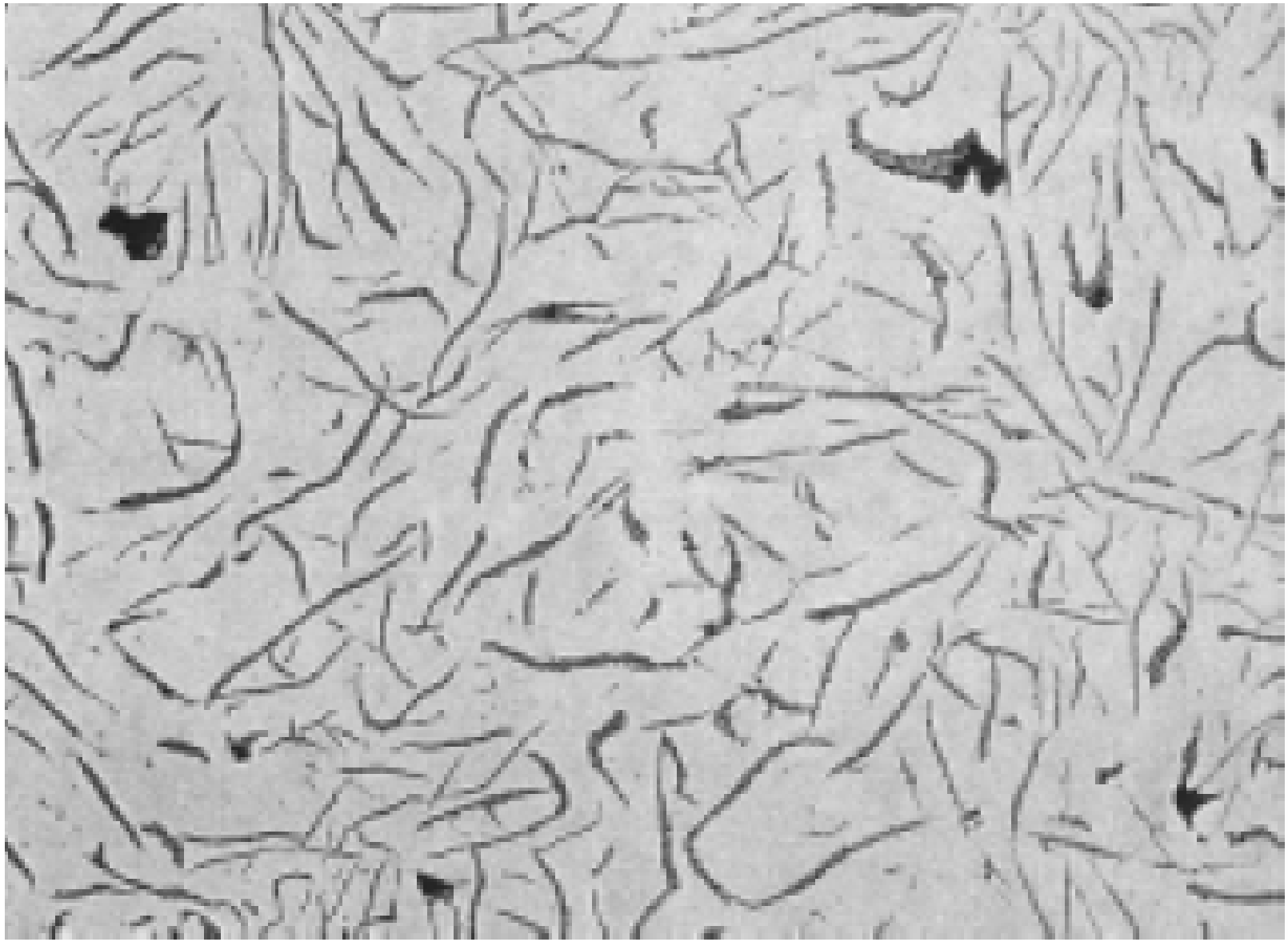
Investigations:

- Study of the dossier.
- Study of reports from institutes
- **Specific information (Internet).**
- Photographs.
- Visit to WTMC (moulder)
- Visit to Stork FDO (VSH)
- Discussion of the report with the specialist in the field of cast iron

Cast Iron Microstructure Anomalies and Their Causes

Cast Iron Quality Control Committee 5J Report
Principle Author:
G.M. Goodrich
Bodycote Taussig, Inc.
Skokie, Illinois

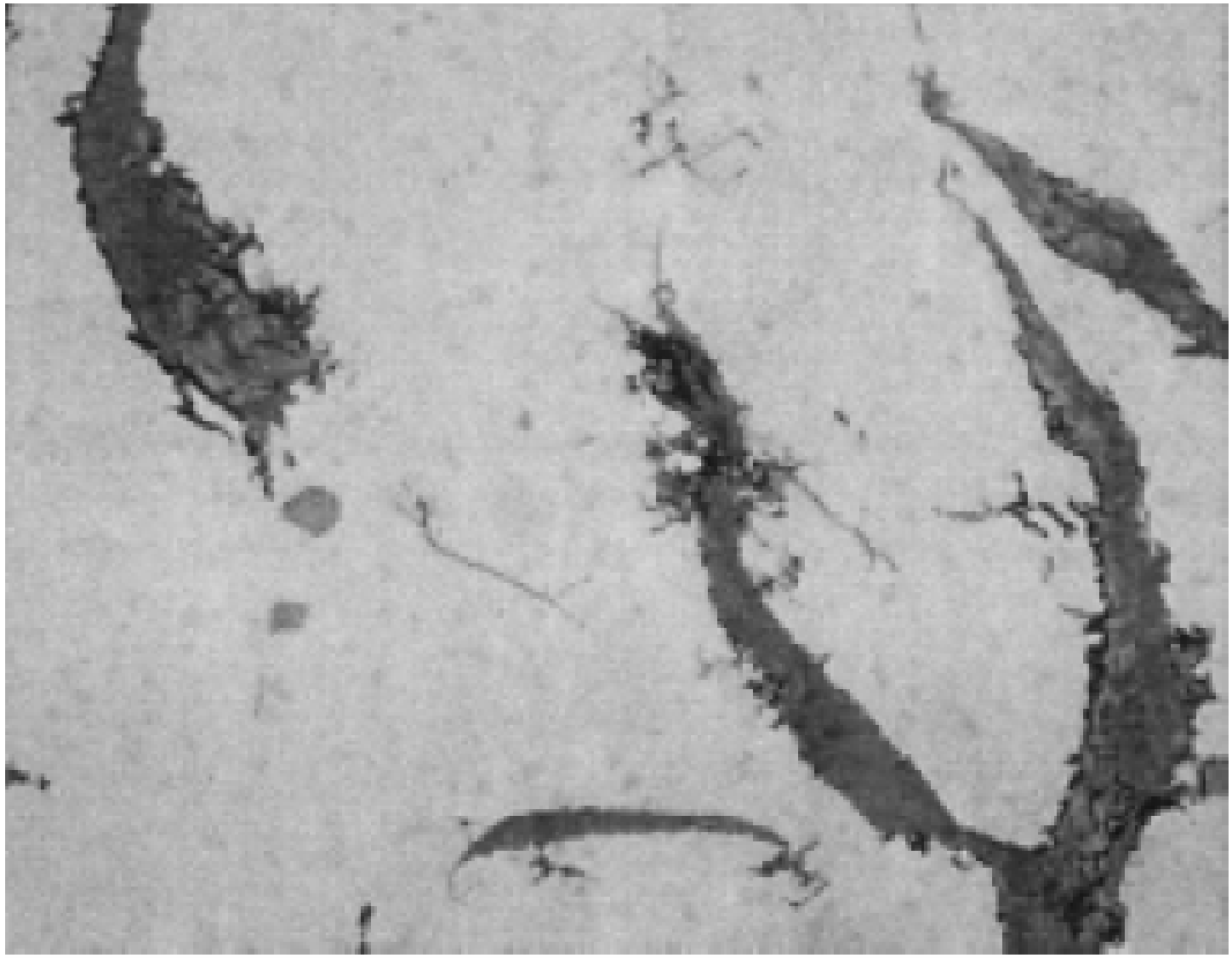
Lead poisoning occurs even if a small amount of lead is present and cooling down is very slow



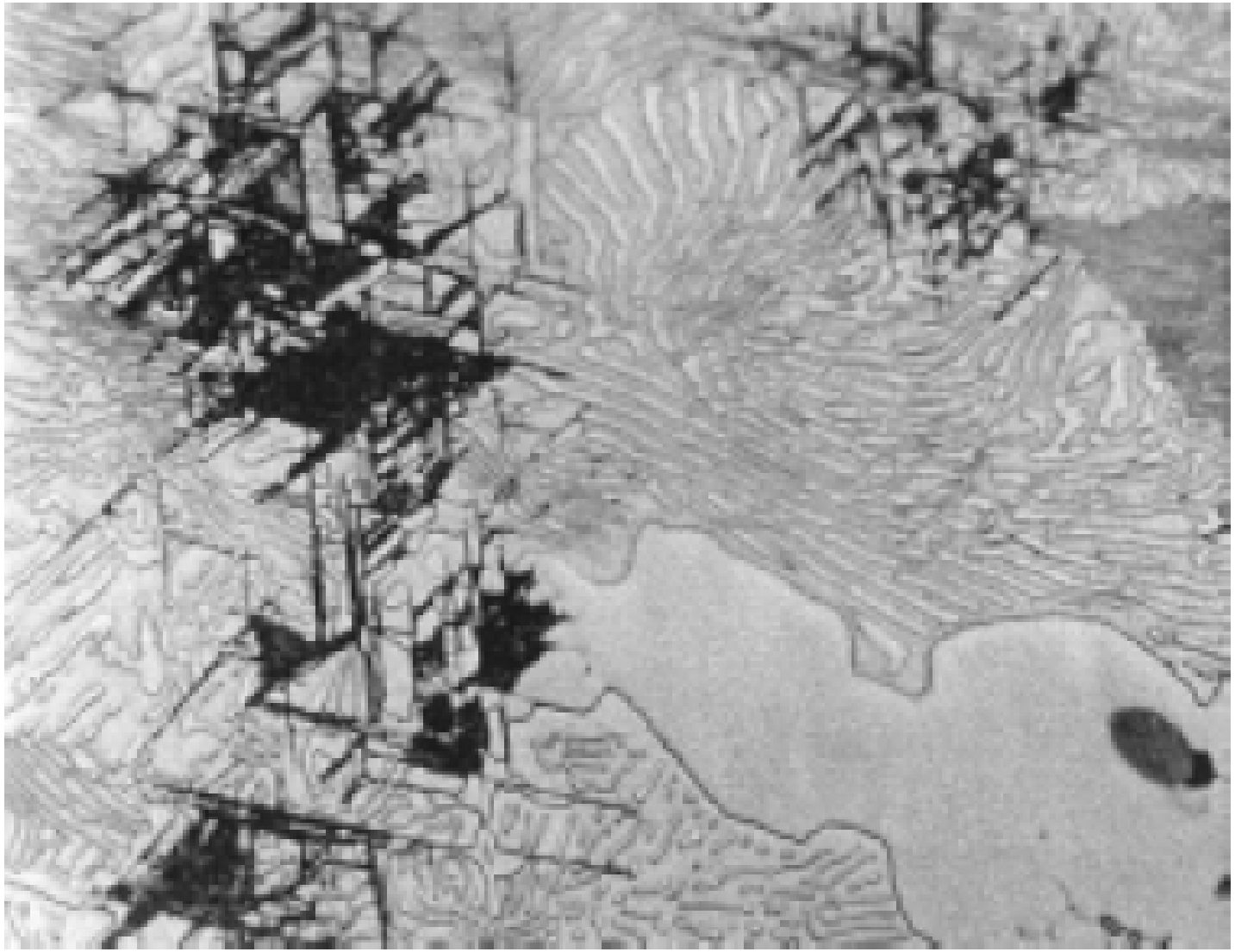
“Normal” graphite structure; (100X, unetched condition).

Graphite appears “fuzzy” and other graphite forms have precipitated within regions between flakes; (400X, unetched condition).

law suit coupling flanges



“fuzzy” graphite is consequence of small fingers of graphite growing on sides of graphite flakes. Also note graphite forms with thin graphite forms in between graphite flakes toward middle and middle top; (1000X, unetched condition).

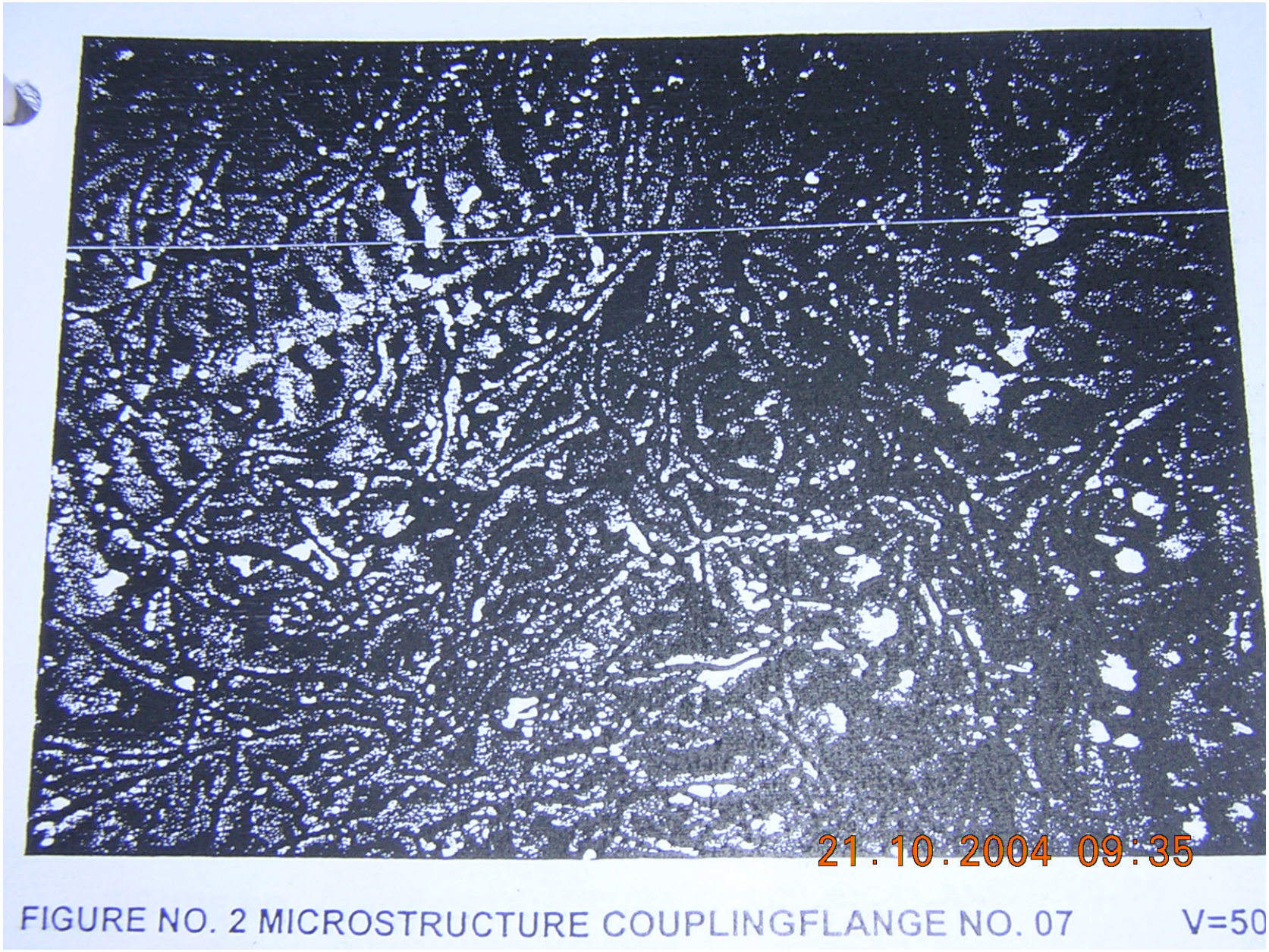


Photomicrograph showing same area seen at lower magnification in Figs. 32 and 33 to further illustrate graphite precipitated on crystallographic planes; (1000X, nital etch).

Investigations:

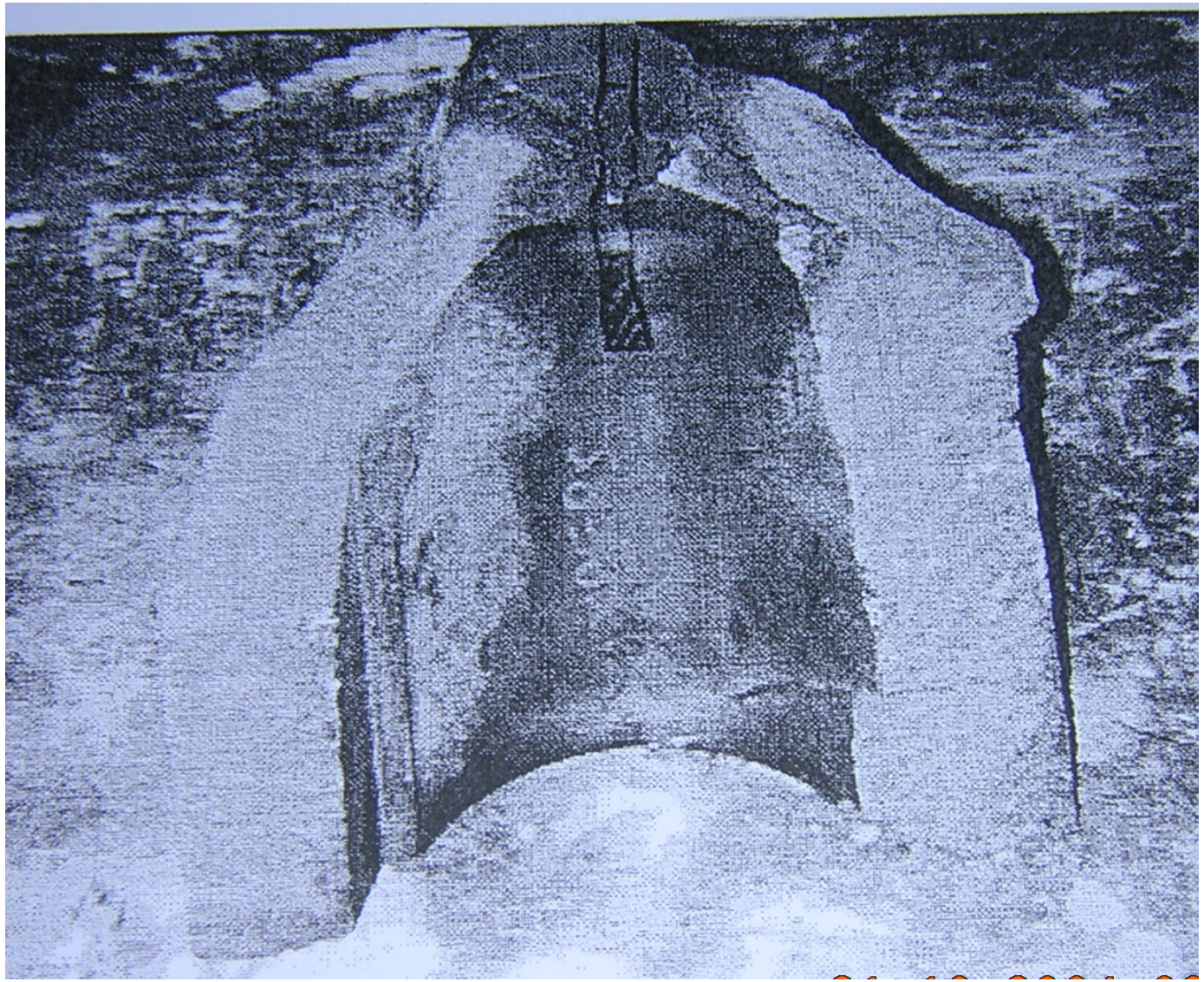
- Study of the dossier.
- Study of reports from institutes
- Specific information (Internet).
- **Sharper photographs.**

  In dossiers from court you will find only copies from copies
- Visit to WTMC (moulder)
- Visit to Stork FDO (VSH)
- Discussion of the report with the specialist in the field of cast iron

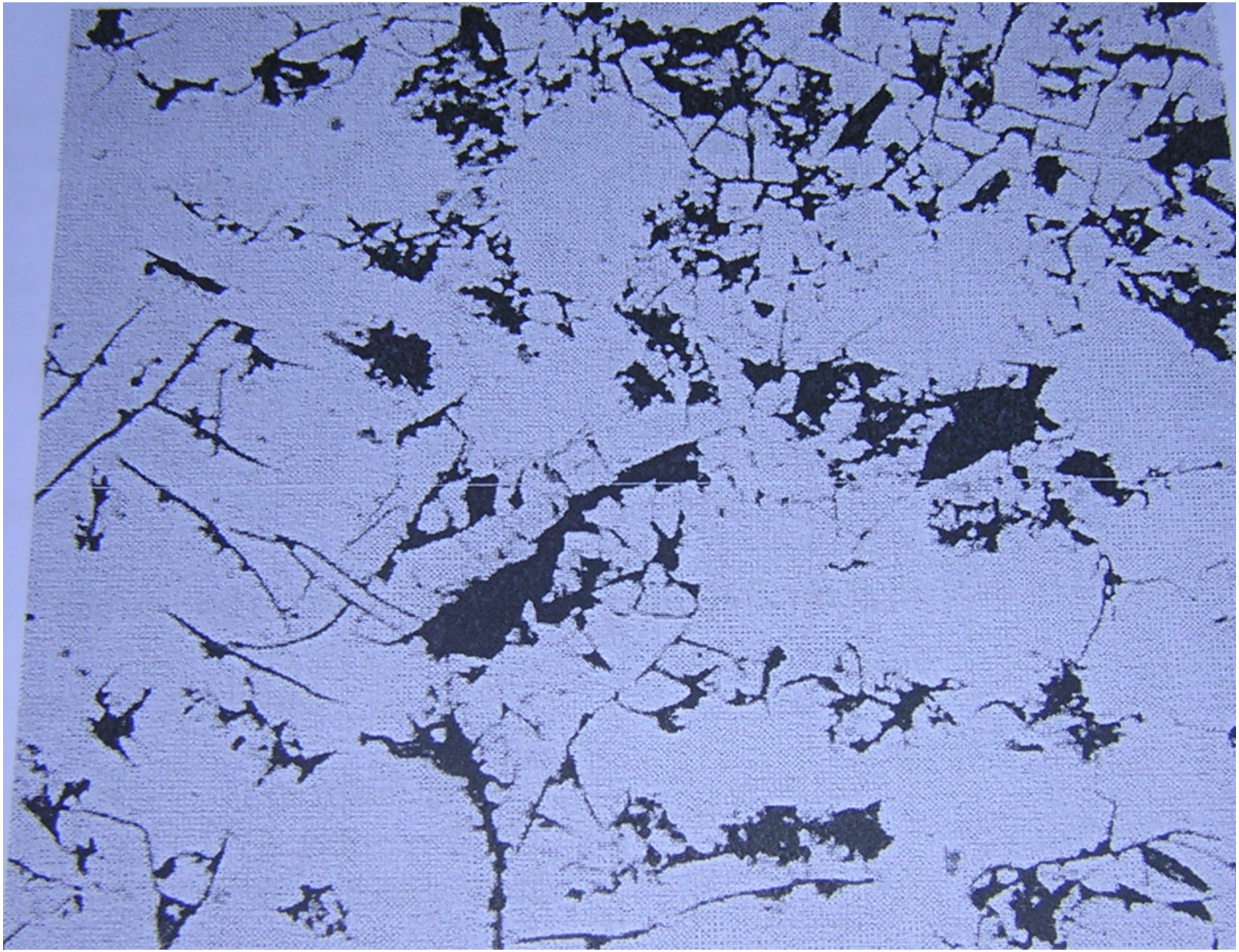

21.10.2004 09:35
FIGURE NO. 2 MICROSTRUCTURE COUPLINGFLANGE NO. 07
V=50

Investigations:

- Study of the dossier.
- Study of reports from institutes
- Specific information (Internet).
- Sharper photographs.
- **Visit to WTMC (moulder)**
- Visit to Stork FDO (VSH)
- Discussion of the report with the specialist in the field of cast iron



Photograph of destructed piece of the coupling at WTCM (Belgium)



Photograph of microstructure determined by WTCM

Visit to WTMC (moulder)

We have told the moulder that lead poisoning is very likely.

After several months no lead was determined anymore.

Investigations:

- Study of the dossier.
- Study of reports from institutes
- Specific information (Internet).
- Sharper photographs.
- Visit to WTMC (moulder)
- **Visit to Stork FDO (HCF)**
- Discussion of the report with the specialist in the field of cast iron

Visit to Stork FDO (HCF)

- Original reports and more details about the investigations.
- Lead percentage was very low.

Investigations:

- Study of the dossier.
- Study of reports from institutes
- Specific information (Internet).
- Sharper photographs.
- Visit to WTMC (moulder)
- Visit to Stork FDO (VSH)
- **Discussion of findings with the specialist in The Netherlands in the field of cast iron**

Discussion of findings with the specialist in The Netherlands in the field of cast iron

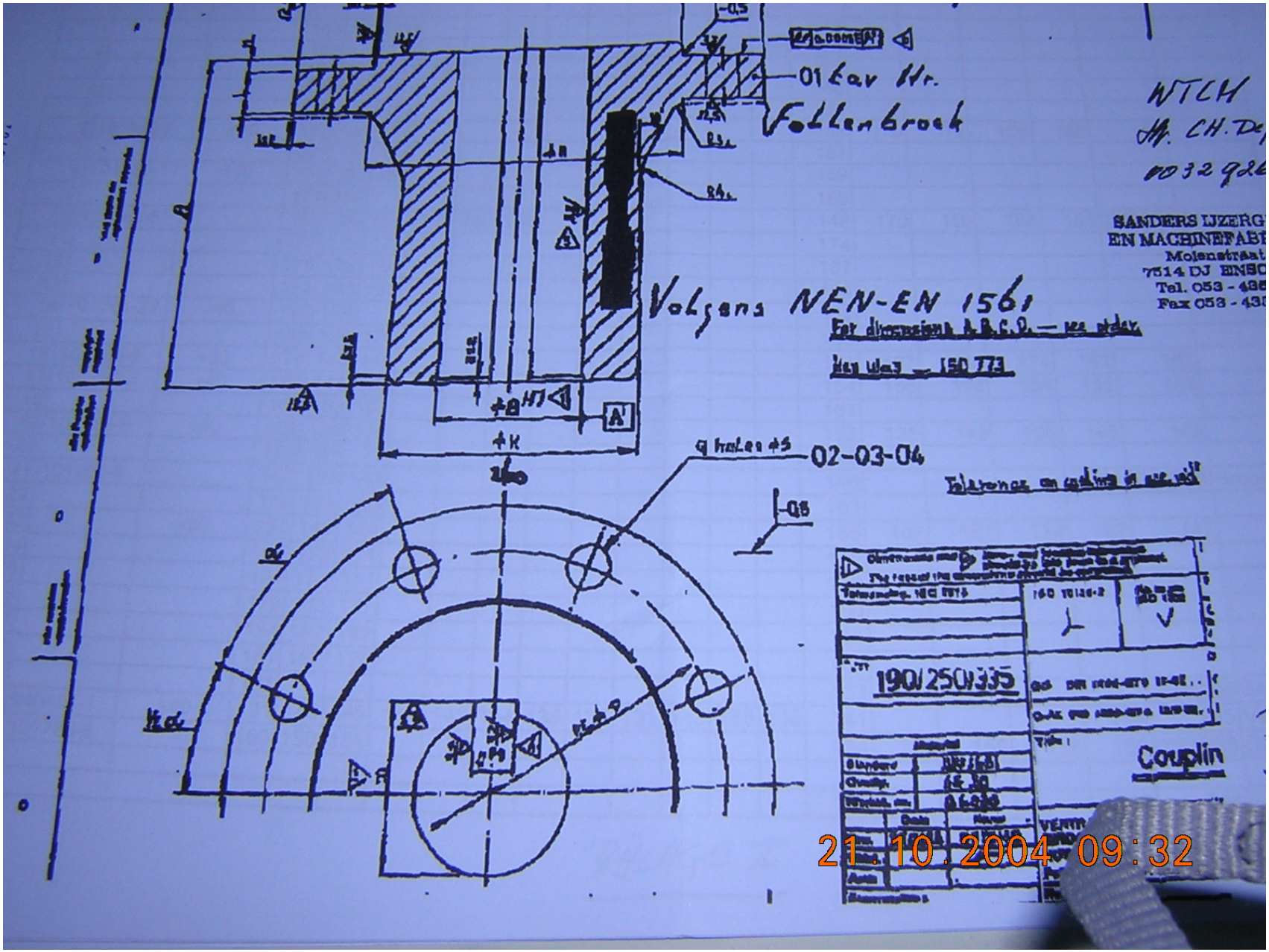
We have jointly answered the questions posed by court.

Which are the expected tensile strength and Brinell-hardness of the coupling flanges of GG25.

Only the tensile strength is relevant; Brinell-hardness is for quality

The standard NEN-EN 1561 indicates a tensile strength of a separately moulded tensile bar between ***250 N/mm² and 350 N/mm²***

The tensile strength ***in a location of a moulding can be found*** *in NEN-EN1561. It depends on the wall thickness: "The wall thickness of the machined coupling is* ***57,5 mm.***
We assume that the wall thickness before machining was not higher than 80 mm. For the cylindrical part a tensile strength of ***170 N/mm² is indicated.****.*


01 Lav Nr.
Follenbroek
WTCH
Volgens NEN-EN 1561
SANDERS IJZERG
EN MACHINEFAB
Molenstraat
7514 DJ ENSC
Tel. 053 - 43
Fax 053 - 43
02-03-04
190/250/335
Couplin
21.10.2004 09:32

law suit coupling flanges

nr	N/mm^2	N/mm^2	N/mm^2		HB	HB	HB
6	148				170	172	156
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30	98				161	156	156

Which **tensile strength** had the **coupling flanges** and was this in according with the specifications?

The tensile strength of the tensile specimens *from the cylindrical part* were between ***76 N/mm² and 195 N/mm²***

.

A substantial number of the tensile strength is far below ***170 N/mm².*** ***This is not according to the*** specifications?

law suit coupling flanges

nr	N/mm^2	N/mm^2	N/mm^2		HB	HB	HB
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- *The cause of the low tensile strength is due to the degenerated microstructure. WTCM and Stork-FDO have determined this*
- *These microstructures occur in thick parts of mouldings, where the cooling rate is low. Small amounts of lead can also cause this microstructure.*
- *There was no evidence that the coupling flanges had been heated over **120 ºC.** Stork-FDO has determined the microstructure over the whole cross section and this was constant.*
- *Only if the flanges had been heated over 200 ºC by a gas flame*

The real cause of the failure

- The moulder was not satisfied with the report and wrote a comment of 14 pages with many questions.
- In his comment it became clear that for reasons of flexibility coupling flanges **without a core had been moulded.**
- **These coupling flanges slipped through the quality control.**

Lesson learned

- Always ask for extra ordinary circumstances.
- Ask for information from all parties involved.