

Recent Progress in Techniques of Manufacturing Small Diameter Electric-Resistance Weld Tubes*

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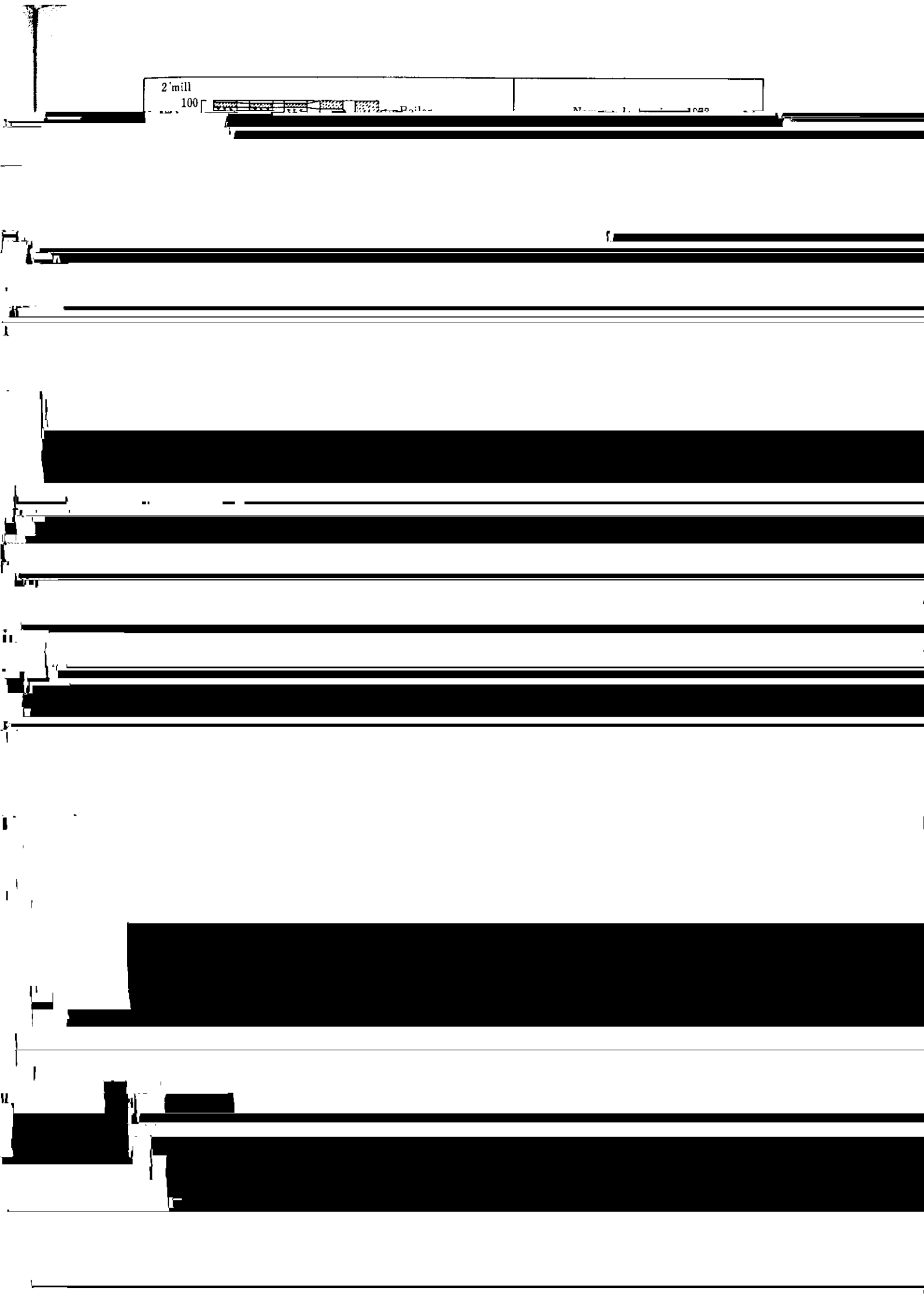
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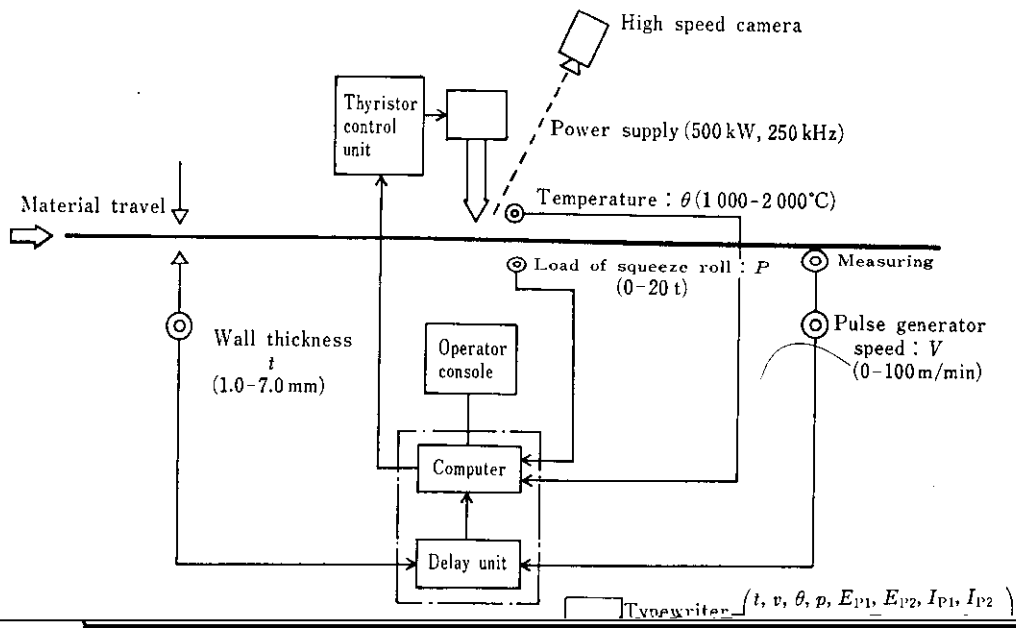
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*To meet an ever-increasing demand for higher-grade small diameter electric-resistance
weld (ERW) tubes such as oil country tubular goods (OCTG), mechanical tubing and*

*boiler tubes, remarkable technical developments have been achieved in the manufacture of
these products. This report deals with some of the achievements made in this field by
Kawasaki Steel Corporation.*

material advanced pipe-making techniques and a





E_p : Plate voltage, I_p : Plate current
 I_g : Grid current

Fig 2 Automatic heat input control system in 2400mm mill

longitudinal variation of sheet coil thickness and the

$$\Delta E = (A \cdot \frac{t - t_s}{t_s} + B \cdot \frac{v - v_s}{v_s})$$

Now, since there is a correlation between the upset

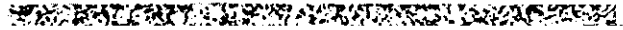
Size (mm) and grade

Amount of

Table 2 API specifications

| Grade | Type | Chemical composition(%) | | | | | | Heat treatment | Yield strength | | Tensile strength | Elongation | Flattening tests | | Hardness |
|-------|------|-------------------------|--|--|--|--|--|-------------------|----------------|-----|---------------------|------------|------------------|---|----------|
| | | | | | | | | | Min | Max | Min | | S | W | |

Pipe size : $5\frac{1}{2}''\phi \times 0.304''t$
Nominal pipe temperature : 00000



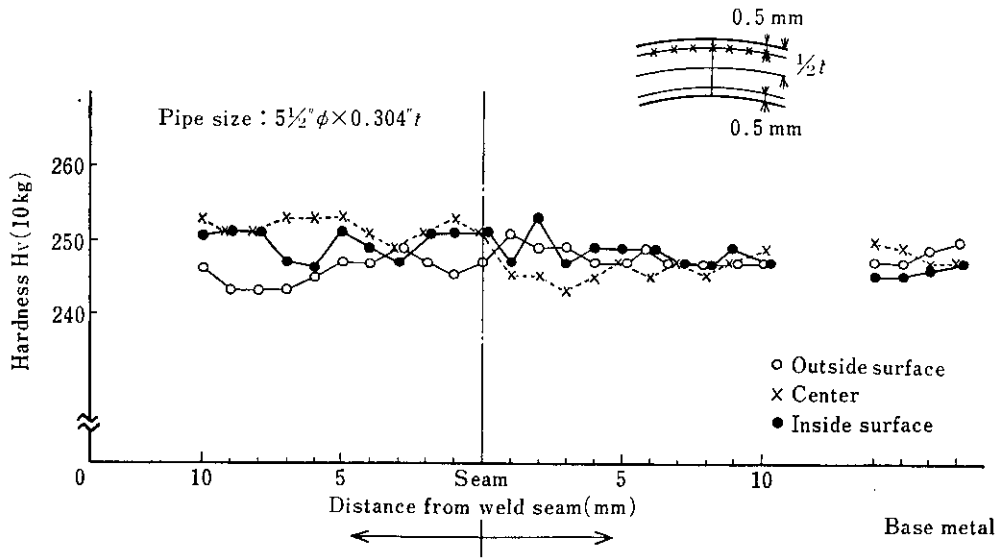


Fig. 8 Hardness distribution of API 5A N-80 across weld

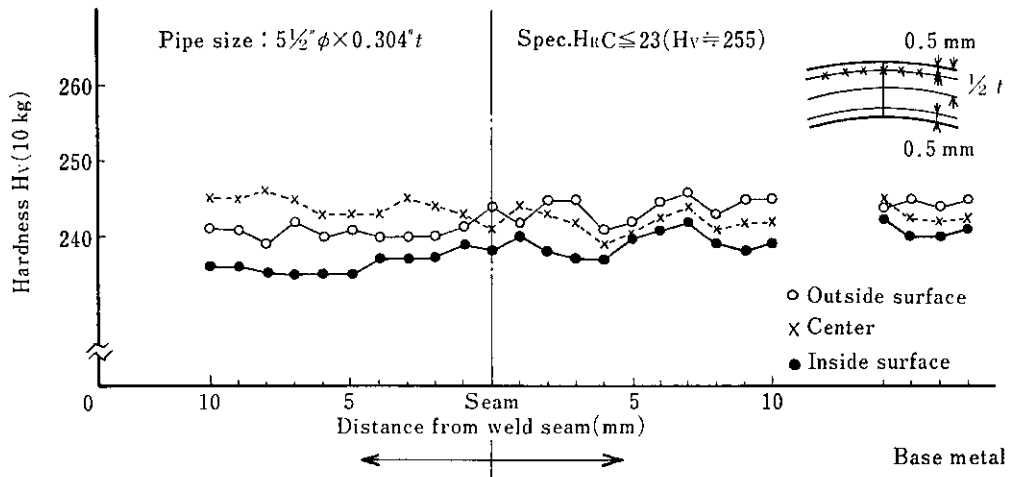


Fig. 9 Hardness distribution of API 5AC L-80 across weld

1.1.1 Weld quality

1.1.2 Collapse strength

The API standard stipulates that the flattening test should be performed as one of the methods for evaluating the strength of weld seam portions. In the case of high strength steel pipes such as those of N-80

One of the factors which affect the collapse strength value is the dimensional accuracy of pipes, namely the degree of out-of-roundness and eccentricity; in the case of the quenched and tempered pipes

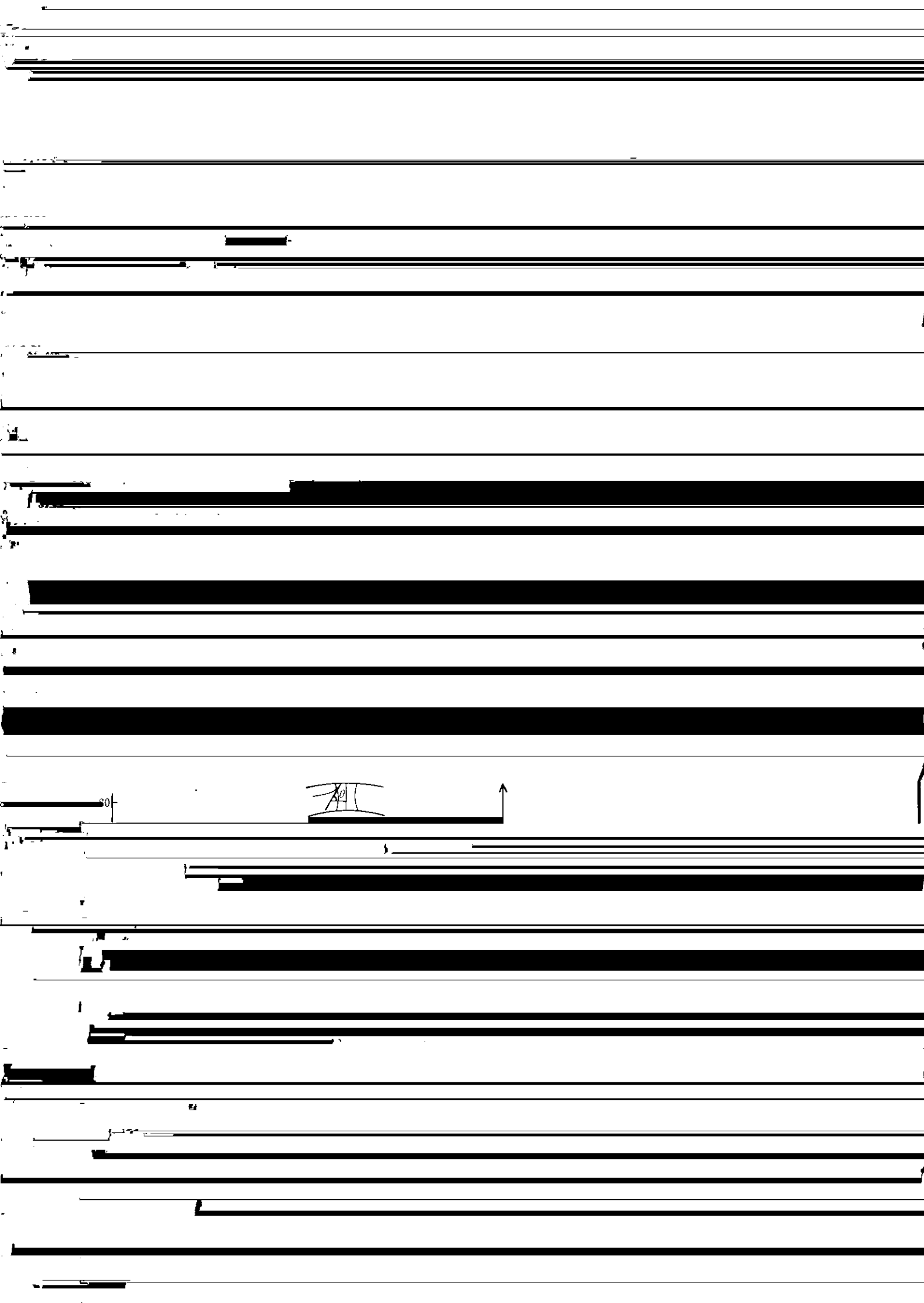


Table 3 Chemical compositions of penetrator in Cr bearing low alloy ERW steel pipes

| Element | Penetrator |
|---------|------------|
| C | 0.20 |
| Mn | 0.30 |
| P | 0.005 |
| S | 0.005 |
| Cr | 0.02 |
| Ni | 0.01 |
| Mo | 0.01 |
| Cu | 0.01 |
| Al | 0.01 |
| Si | 0.01 |
| Fe | Balance |

Table 4 Measured melting temperature of various FeO-MnO-SiO₂-Cr₂O₃ oxides

| Sample No. | Composition (wt%) | Measured Melting Temperature (°C) |
|------------|---|-----------------------------------|
| 1 | FeO: 50, MnO: 40, SiO ₂ : 10 | 1500 |
| 2 | FeO: 40, MnO: 50, SiO ₂ : 10 | 1450 |
| 3 | FeO: 30, MnO: 60, SiO ₂ : 10 | 1400 |
| 4 | FeO: 20, MnO: 70, SiO ₂ : 10 | 1350 |
| 5 | FeO: 10, MnO: 80, SiO ₂ : 10 | 1300 |
| 6 | FeO: 50, MnO: 30, SiO ₂ : 10, Cr ₂ O ₃ : 10 | 1550 |
| 7 | FeO: 40, MnO: 40, SiO ₂ : 10, Cr ₂ O ₃ : 10 | 1500 |
| 8 | FeO: 30, MnO: 50, SiO ₂ : 10, Cr ₂ O ₃ : 10 | 1450 |
| 9 | FeO: 20, MnO: 60, SiO ₂ : 10, Cr ₂ O ₃ : 10 | 1400 |
| 10 | FeO: 10, MnO: 70, SiO ₂ : 10, Cr ₂ O ₃ : 10 | 1350 |
| 11 | FeO: 50, MnO: 30, SiO ₂ : 10, Cr ₂ O ₃ : 10, Al ₂ O ₃ : 10 | 1600 |
| 12 | FeO: 40, MnO: 40, SiO ₂ : 10, Cr ₂ O ₃ : 10, Al ₂ O ₃ : 10 | 1550 |
| 13 | FeO: 30, MnO: 50, SiO ₂ : 10, Cr ₂ O ₃ : 10, Al ₂ O ₃ : 10 | 1500 |
| 14 | FeO: 20, MnO: 60, SiO ₂ : 10, Cr ₂ O ₃ : 10, Al ₂ O ₃ : 10 | 1450 |
| 15 | FeO: 10, MnO: 70, SiO ₂ : 10, Cr ₂ O ₃ : 10, Al ₂ O ₃ : 10 | 1400 |

SiO₂



FeO-MnO-SiO₂

1712°



1785°

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

6 Conclusion

The recent trend toward higher grade of small

References

1) S. Sugimura, K. Okuyama, T. Fukuda and H. Nakasui.