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Manufacturing of New 26-inch ERW High-Test Line Pipe

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Synopsis :
A cage forming type ERW mill newly installed at Chita Works, Kawasaki Steel Corporation, is one of the world's largest of its kind, capable of producing high quality steel pipes up to 26" (660.4mm) in outside diameter and 0.63" (16.0mm) in wall thickness. Factors contributing to the improved product quality of the new mill have been examined and the following results have been obtained: (1) The application of vertical-bending type caster with shielding is effective in reducing weld defects. (2) Controlled rolling techniques have made it

Manufacturing of New 26-inch ERW High-Test Line Pipe*

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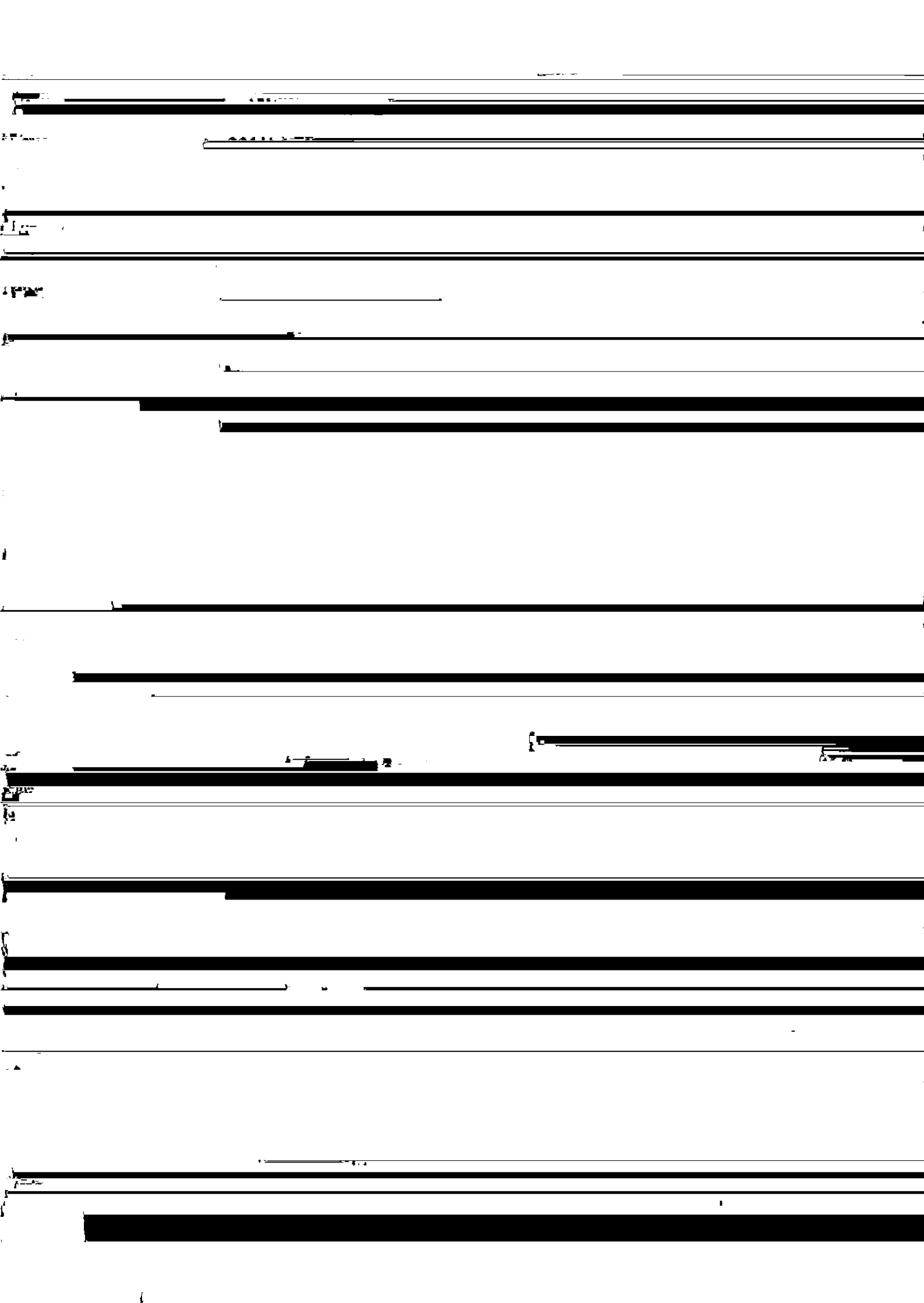
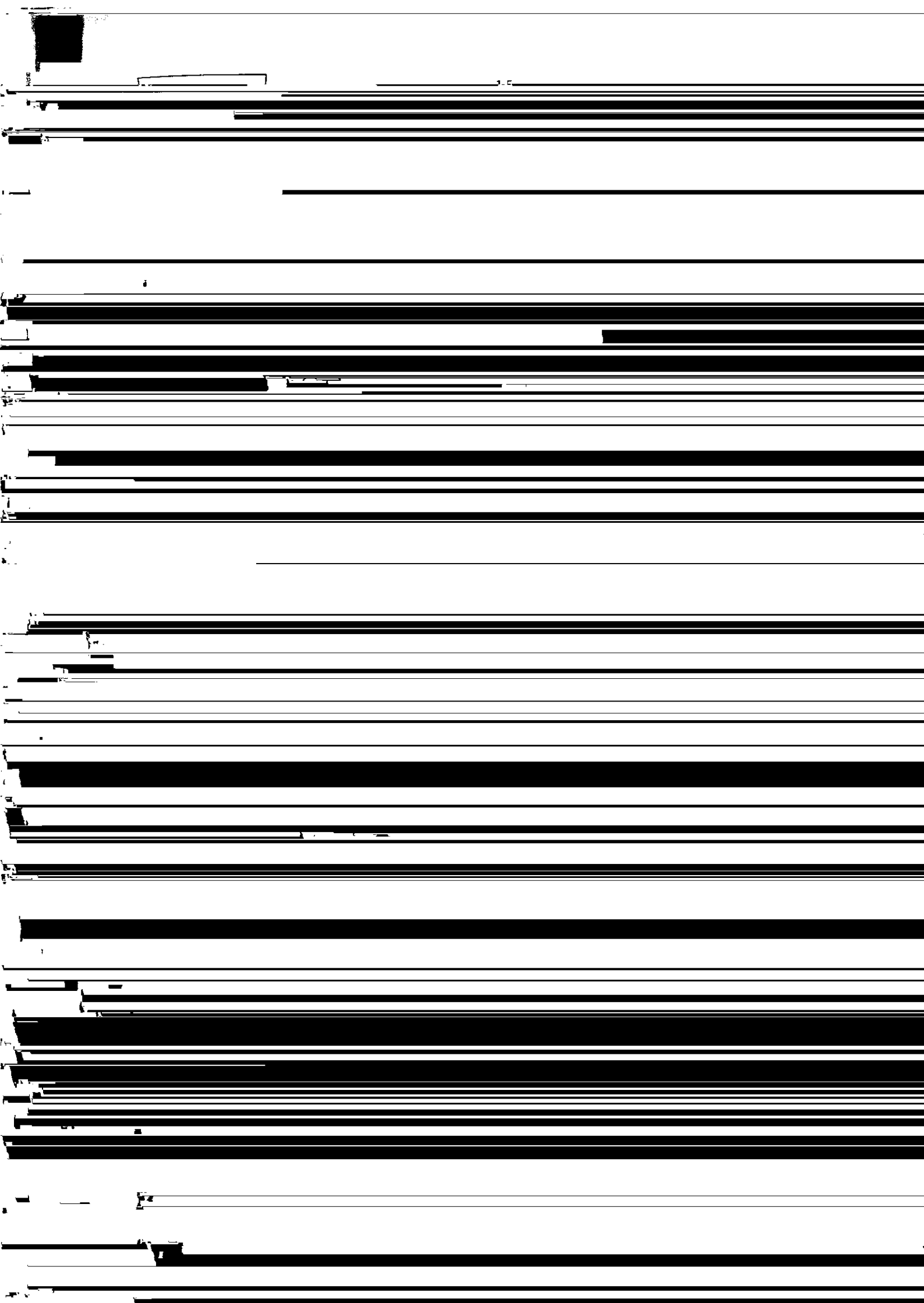
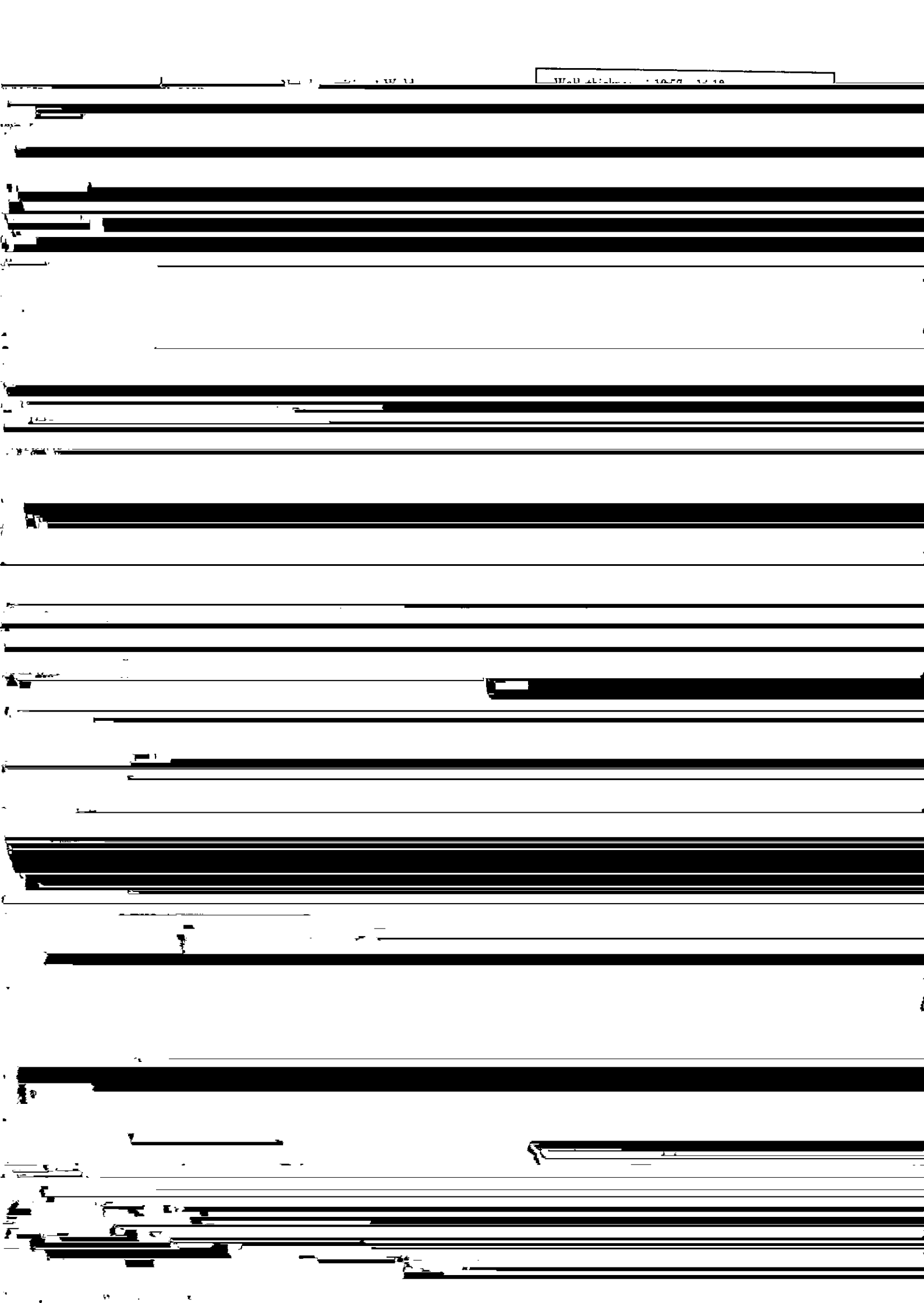
A cage forming type ERW mill newly installed at Chita Works, Kawasaki Steel

Table 1 API requirements for heat analysis (Twenty- second edition)

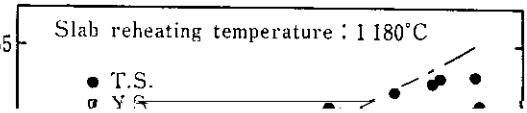
(Twenty-second Edition, API)

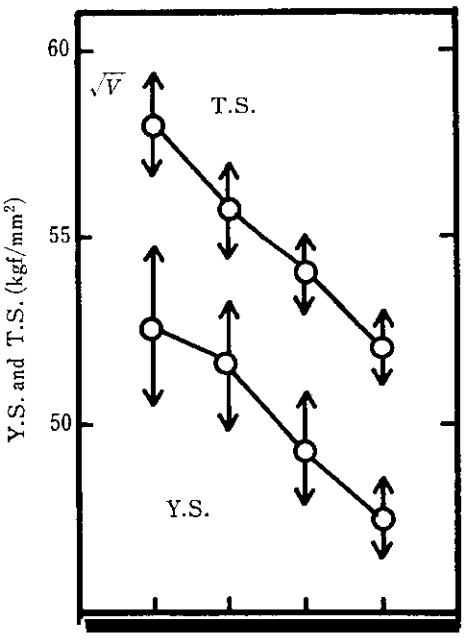


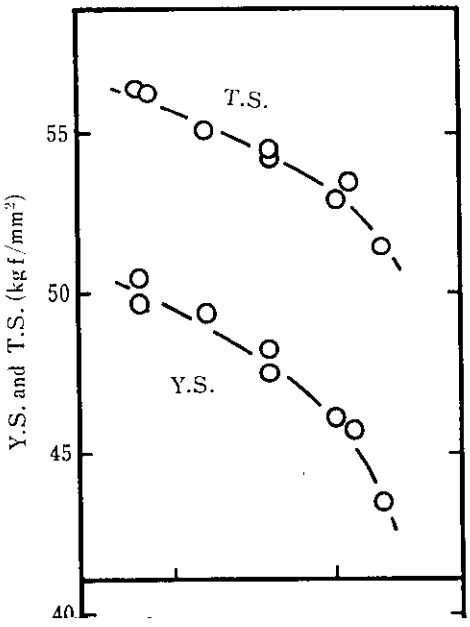




Nb (C, N) is completely dissolved, the austenite grains at the time of reheating can be made finer and the toughness can be improved even more.




60
55
50
$\sqrt{V}$
T.S.
Y.S.
Y.S. and T.S. (kgf/mm²)


55
50
45
40
T.S.
Y.S.
Y.S. and T.S. (kgf/mm²)

in manufacturing hot coils, a proper coiling tem-

prevention. Generally speaking, it is more difficult

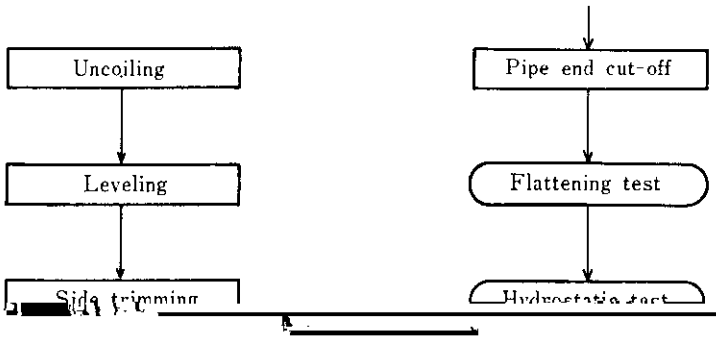
were adjusted by other factors.

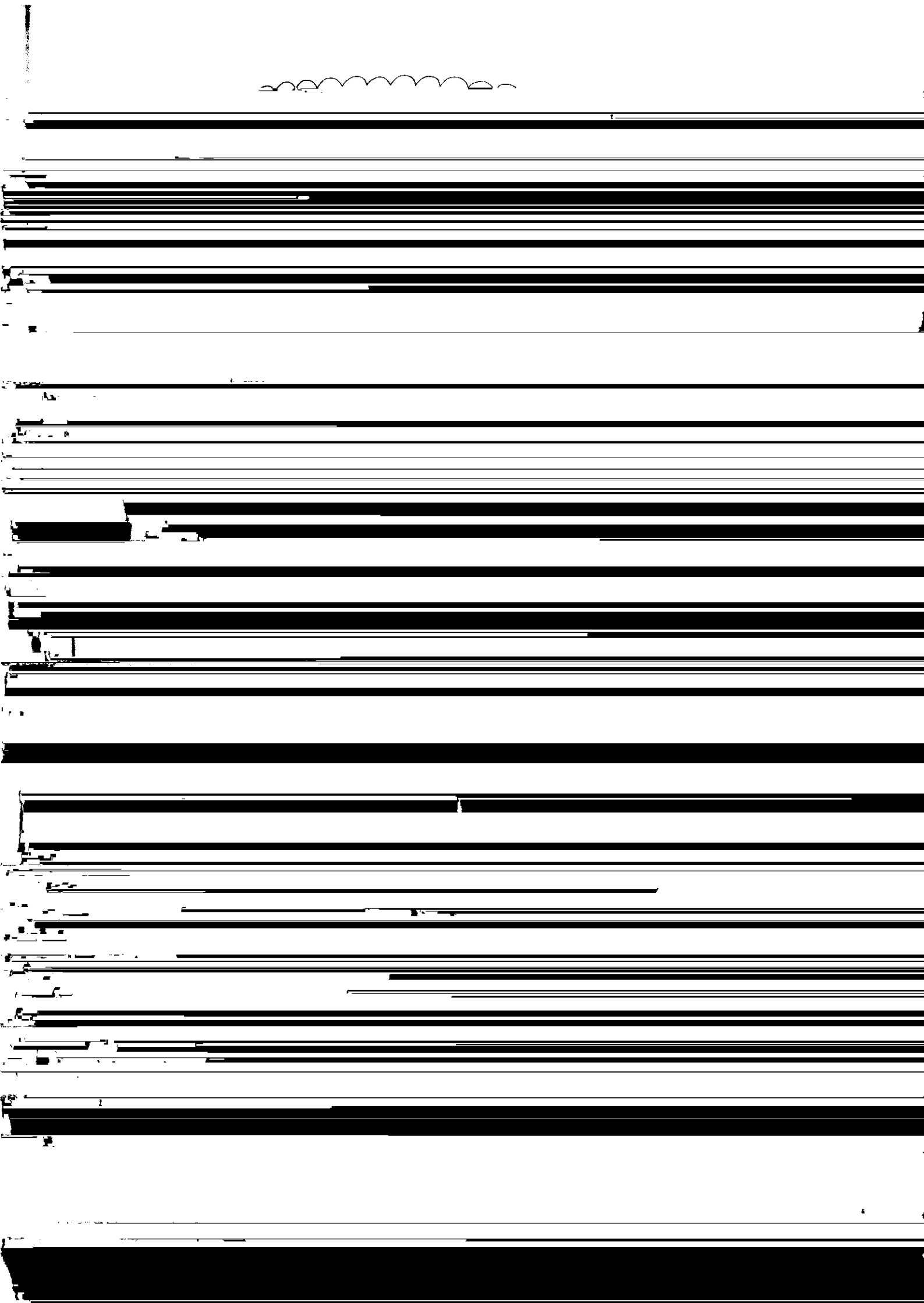
strength, large-width material, but good appear-

The factors that exert an influence upon the mechanical properties, as well as their effects have been described above. Thus, in carrying out material design, it is necessary to study properties requirement and combine each condition so that the optimum material may be obtained.

ance of hot coil is secured by ensuring correct tension in coiling, and proper gap between pinch roll and wrapper roll and by setting up an adequate pressure of the wrapper roll cylinder as well as by making use of a bending roll before the pinch roll as shown in **Fig. 13**. This is because restraining force acts against the force in the cross direction

Forming	Full-cage roll forming type


Uncoiling
Leveling
Pipe end cut-off
Flattening test



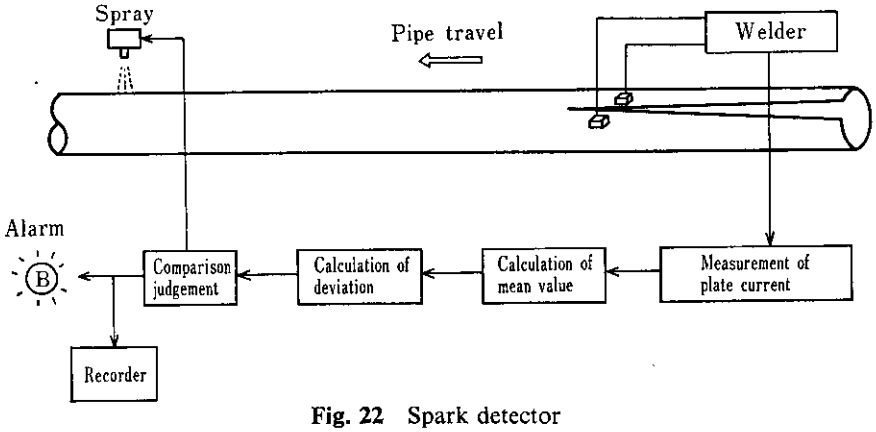


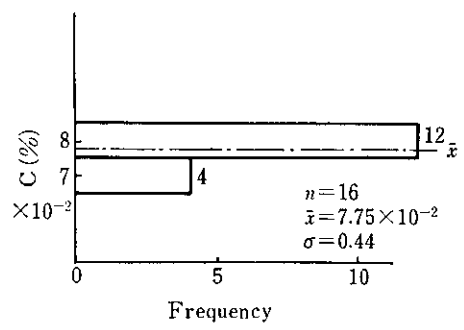
Fig. 22 Spark detector

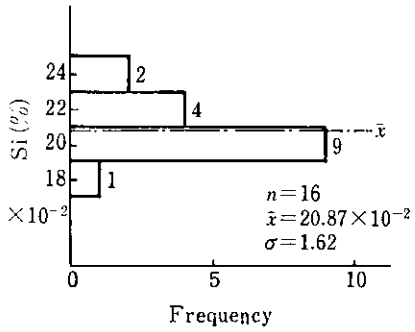
order to bring about an improvement in the

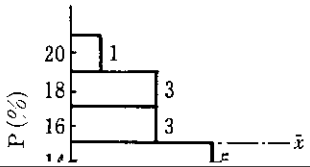
defects, nonmetallic inclusions, etc. in the upsetting

etc., there is a trend toward the severer control of products with the higher quality of products. In order to cope with these situations, an automatic

From the tensile properties and Charpy impact properties shown in **Fig. 24** and from the DWTT transition temperature in **Fig. 26**, it is clear that

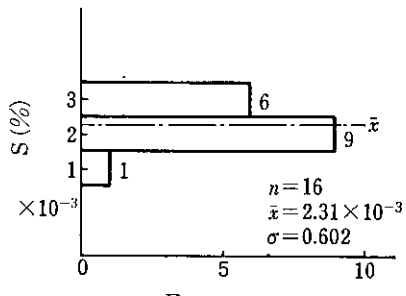


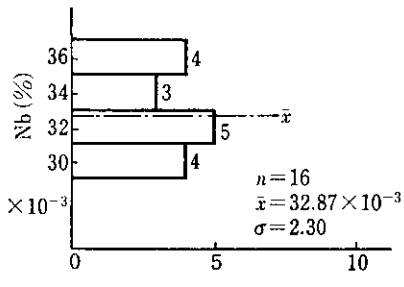


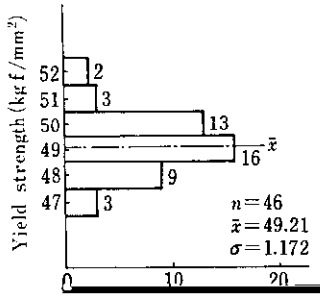


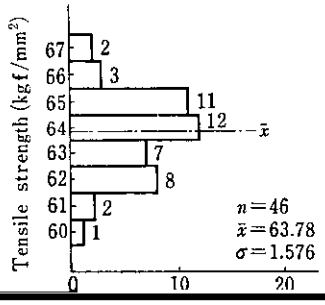
Frequency

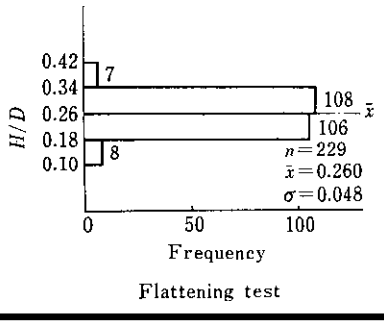
Frequency

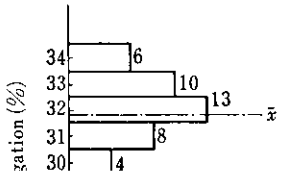


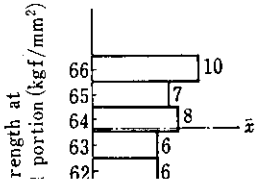


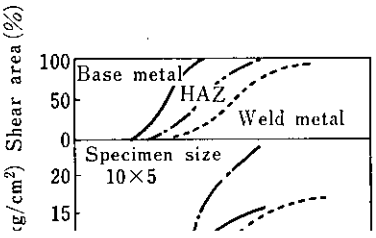

Yield strength (kgf/mm²)
52 2
51 3
50 13
49 16 x̄
48 9
47 3
n=46
x̄=49.21
σ=1.172
0 10 20
Frequency

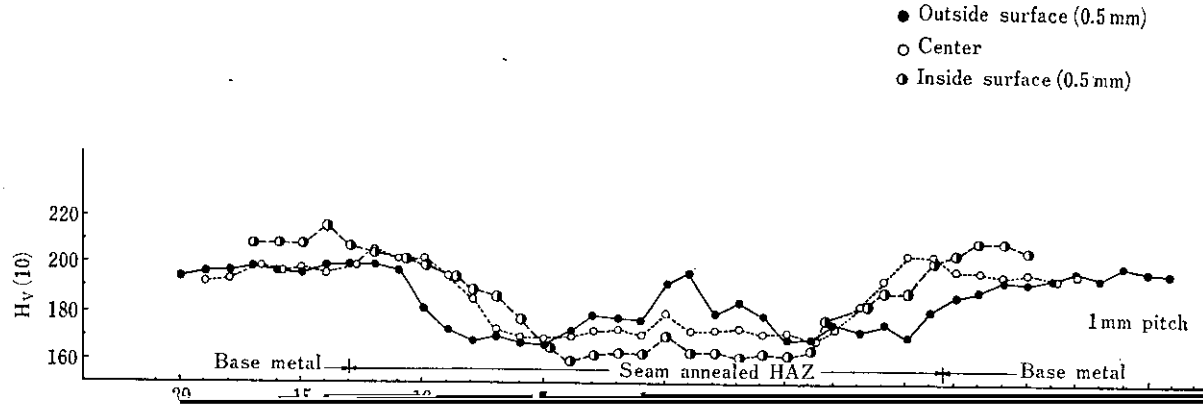

Tensile strength (kgf/mm²)
67 2
66 3
65 11
64 12 x̄
63 7
62 8
61 2
60 1
n=46
x̄=63.78
σ=1.576
0 10 20
Frequency


H/D
0.42 7
0.34
0.26 108 x̄
0.18 106
0.10 8
n=229
x̄=0.260
σ=0.048
0 50 100
Frequency
Flattening test

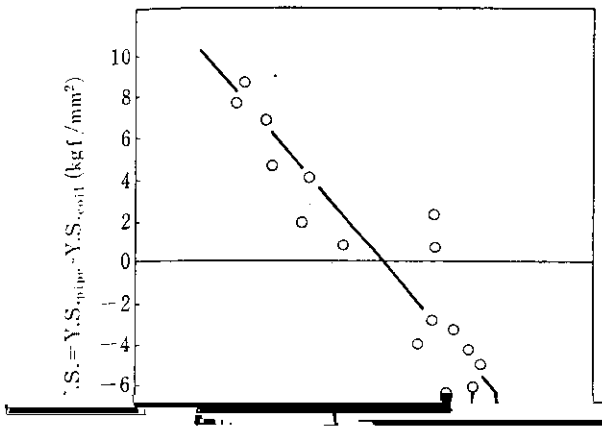

gation (%)
34 6
33 10
32 13 x̄
31 8
30 4


rength at
portion (kgf/mm²)
66 10
65 7
64 8 x̄
63 6
62 6


Shear area (%)
100
50
0
Base metal
HAZ
Weld metal
Specimen size
10×5
20
15
cg/cm²)



Distance from weld seam (mm)



The relationship between Y.S. and t/D (wall thickness/outside diameter) in the API 5LX X60–65, and 26 in. ERW pipes of high strength is shown in **Fig. 29**. The Bauschinger effect is affected not only by the coil strength of hot coils but also by pipe dimensions, and the less t/D is, the more the Y.S. reduction after the pipe-making process.

The comparison of yield strength by internal pressure measured by the ring expansion test with Y.S. measured by the flattened sheet tension test (both sampled before the on-line hydrostatic test) is shown in **Fig. 30**. It is clear from this figure that, when an expanding process is provided as in the case of the

hydrostatic test is somewhat larger than that of the tensile strength, and this nearly agrees with the experimental equation:

$$Y = 1.034X$$

which was obtained by Hasebe et al[19].

$\sigma_{Y.S.} = \sigma_{20(Y.S.)} \exp\{1\,067.9$

3) E. Yokoyama, H. Ohtsubo, M. Yamagata & I. Sugimoto: