KAWASAKI STEEL GIHO
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# 2-1/4　3Cr-1
# High Strength 2-1/4 and 3%Cr-1%Mo Steels with Excellent Hydrogen Attack Resistance

(Jun-ichi Shimomura)

# High Strength 2¼ and 3% Cr-1% Mo Steels with Excellent Hydrogen Attack Resistance


要旨

Table 1 Chemical compositions of laboratory steels used (mass %)

| Steel | C | Si | Mn | P | S | Cr | Mo | V | Nb | Ti | Al | B | REM* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0.13 | 0.05 | 0.52 | 0.004 | 0.001 | 2.37 | 1.09 | 0.25 | 0.021 | — | 0.03 | — | — |
| B | 0.13 | 0.06 | 0.52 | 0.004 | 0.001 | 2.37 | 1.09 | 0.31 | 0.021 | — | 0.03 | — | 0.004 |
| C | 0.13 | 0.06 | 0.53 | 0.003 | 0.001 | 2.43 | 1.10 | 0.35 | 0.021 | — | 0.03 | — | 0.006 |
| D | 0.13 | 0.06 | 0.51 | 0.003 | 0.001 | 2.33 | 1.07 | 0.30 | 0.021 | 0.010 | 0.03 | 0.0010 | 0.004 |

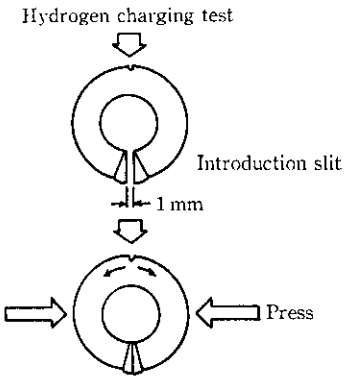
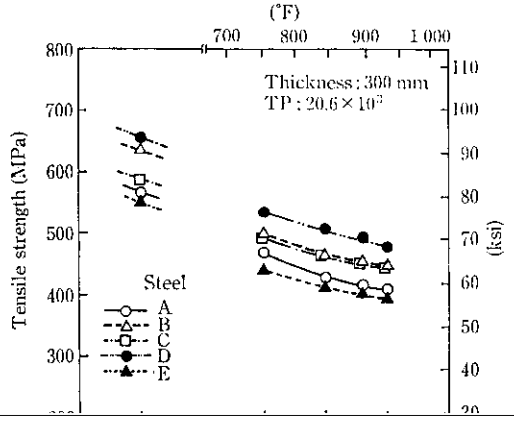
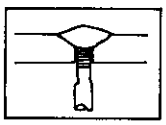



Fig. 1 Hydrogen attack test using cylinder type restraint cracking specimen (IHI[1])




R.T. 400 450 500 550
Test temperature (℃)



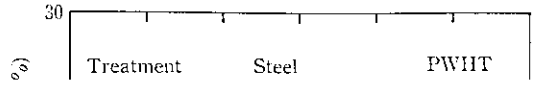
Submerged-arc weld bead

Base plate and test specimens after welding

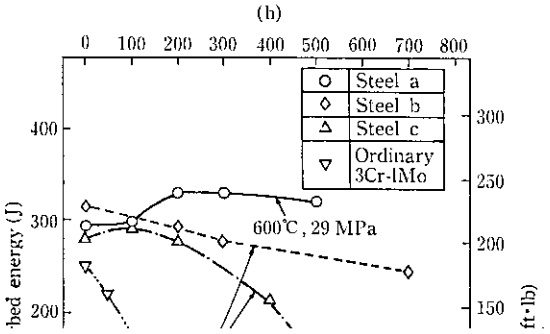
steel

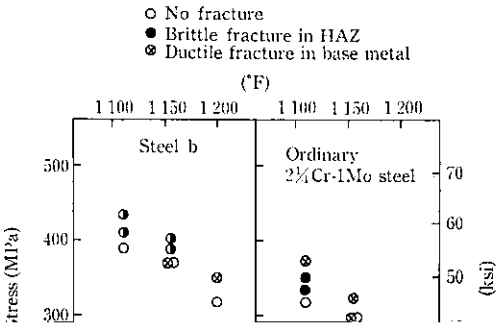
mm

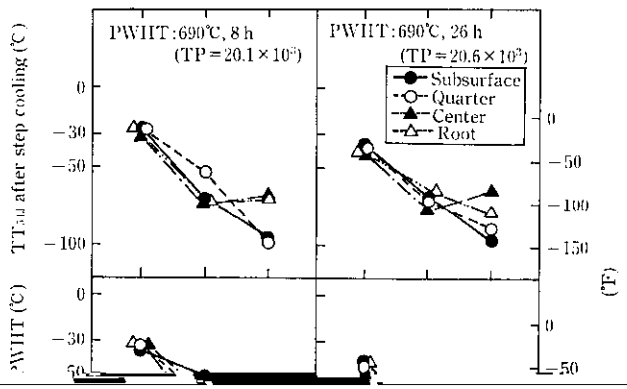
Cr-1 Mo 鋼(鋼 E)，3 Cr-1 Mo 鋼(鋼 F) はいずれも短時間の暴露により水素侵食を受け，${}_vE_0^*/{}_vE_0$ が大きく低下する。両者の比較では $2\frac{1}{4}$ Cr-1 Mo 鋼の方が 3 Cr-1 Mo 鋼に比べ ${}_vE_0^*/{}_vE_0$ の低下が短時

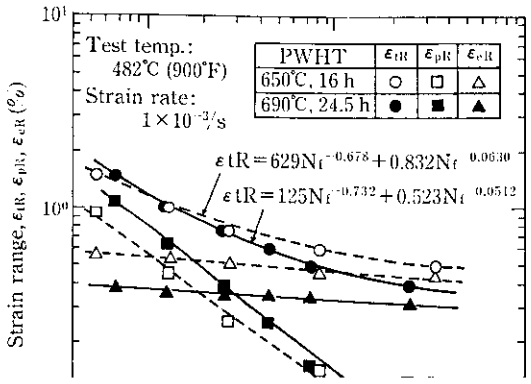


Tempering parameter, $T$ (R)[20+log $t$ (h)]×$10^{-3}$


(b)
0 100 200 300 400 500 600 700 800
Steel a
Steel b
Steel c
Ordinary 3Cr-1Mo
600°C, 29 MPa
400
300
200
300
250
200
150
bed energy (J)
ft·lb)


○ No fracture
● Brittle fracture in HAZ
⊗ Ductile fracture in base metal
(°F)
1 100 1 150 1 200
1 100 1 150 1 200
Steel b
Ordinary 2¼Cr-1Mo steel
500
400
300
70
60
50
(ksi)
ress (MPa)


PWHT:690℃, 8 h
(TP=20.1×10³)
PWHT:690℃, 26 h
(TP=20.6×10³)
Subsurface
Quarter
Center
Root
PWHT (℃)
TTau after step cooling (℃)
(F)


Test temp.:
482℃ (900°F)
Strain rate:
1×10⁻³/s
PWHT
650℃, 16 h
690℃, 24.5 h
εtR=629Nf^-0.678+0.832Nf^-0.0630
εtR=125Nf^-0.732+0.523Nf^-0.0512
Strain range, εtR, εpR, εcR (%)