HYDROGENIUS
水素材料先端科学研究センター

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HYDROGENIUS DATABASE

— Hydrogen Transport Properties —

No. B30

Database of Hydrogen Transport Properties of JIS-SCM435 Low-Alloy Steel for Use in a 20-MPa-Hydrogen Storage Cylinder

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Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
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1. MATERIAL

Table 1. Related properties.

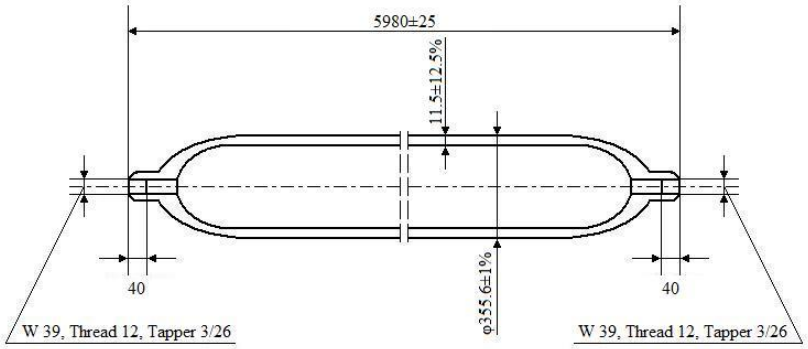


Table 2. Chemical composition of SCM435.

			Element (mass%)						
			C	Si	Mn	P	S	Cr	Mo
Product Analysis	Present Material[1)]		0.30	0.32	0.62	0.029	0.011	0.91	0.19
Ladle Analysis	Requirements[2)]	Max.	0.38	0.35	0.85	0.030	0.030	1.20	0.30
		Min.	0.33	0.15	0.60			0.90	0.15

[1)] As performed at HYDROGENIUS.
[2)] As per JIS G 3441:1988, *"Alloy Steel Tubes for Machine Purpose"*.

Table 3. Heat-treatment.

Quenching	Tempering

It should be noted that the following data are identical to those featured in HYDROGENIUS DATABASE No.5: Tables 1, 2, 3, 4 and 5.

2. MECHANICAL PROPERTIES

Table 4. Tensile properties.

$\sigma_{0.2}$: 0.2% Proof strength
σ_B : Tensile strength
ε_u : Uniform elongation
ε_f : Total elongation
φ : Reduction of area
C_H : Hydrogen content

(a) Circumferential direction (C-specimens)

	Tensile properties					Hydrogen content
	$\sigma_{0.2}$ (MPa)	σ_B (MPa)	ε_u (%)	ε_f (%)	φ (%)	C_H (mass ppm)
Uncharged	650	807	7.1	17.3	60.9	0.0
Hydrogen-charged	646	802	7.4	17.1	54.6	0.3
	649	801	6.8	14.8	54.8	0.3
	652	803	6.4	13.8	54.0	0.3
	630	783	6.4	13.9	53.9	0.3

(b) Longitudinal direction (L-specimens)

	Tensile properties					Hydrogen content
	$\sigma_{0.2}$ (MPa)	σ_B (MPa)	ε_u (%)	ε_f (%)	φ (%)	C_H (mass ppm)
Uncharged	655	801	6.5	17.1	66.1	0.0
Hydrogen-charged	668	818	7.3	16.1	59.2	0.3
	650	806	7.0	16.2	57.6	0.4
	659	808	7.0	16.7	58.6	0.3

Table 5. Average value of Vickers hardness.

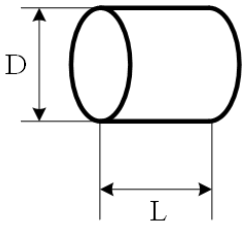
Vickers hardness
$\overline{HV}$
272

It should be noted that the following data are identical to those featured in HYDROGENIUS DATABASE No.5: Tables 1, 2, 3, 4 and 5.

3. HYDROGEN TRANSPORT PROPERTIES

Table 6. Hydrogen-charging and hydrogen-measurement conditions.

(a) Hydrogen-charging conditions.

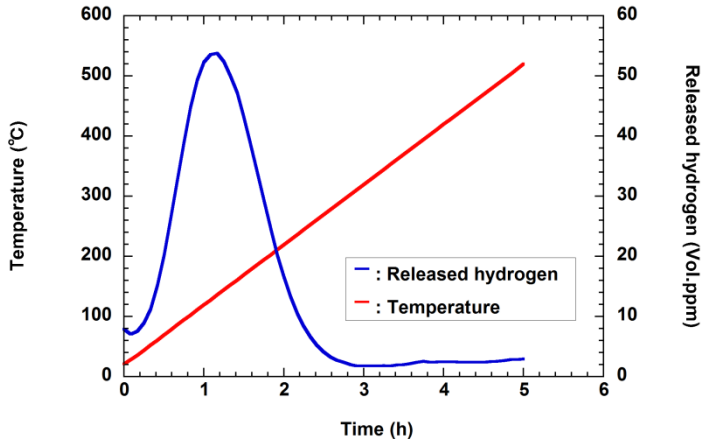
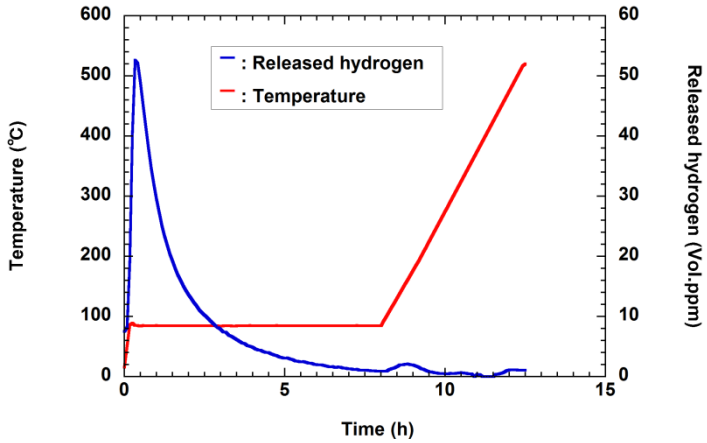
Type of hydrogen-charging	Exposure to hydrogen gas at a pressure of 100 MPa
Hydrogen-gas purity	99.999%
Hydrogen-gas temperature & holding time	358 K, Over 200 h
Specimens[1), 2)]	 $D = L$ = 11 mm, 7 mm

[1)] Specimens were cut so as to be equal in diameter and in length.
[2)] Surface-finishing was performed by circumferential-polishing with 2000-grade silicon-carbide paper.

(Table continues on the following page)

Table 6. Hydrogen-charging and hydrogen-measurement conditions. (Continued)

(b) Hydrogen-measurement conditions.

Type of spectroscope	TDA (Thermal Desorption Analysis) Hydrogen detection accuracy : 0.3 Vol. ppm Amount of hydrogen molecule detection : 6.1×10^{-10} mol/min
Measurement methods and conditions	 (a) Multiple-specimen measurement method. Measurement condition : 100°C/h from 20°C to 520°C  (b) Single-specimen measurement method. Measurement condition: 100°C/h from 20°C, maintaining at 50°C, 70°C or 85°C, then increasing up to 520°C.