Report

Introduction of AIS2100

1. New AIS2100 system

(1) Advanced H/W

(2) Upgraded S/W algorithms

2. Testing result comparison (GE specimens)

: AIS2000 and AIS2100

Prepared by

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1. AIS2100 system

AIS2100, like AIS2000, is a portable indentation system for nondestructive evaluation of tensile properties. But AIS2100 comprises more precise hardware, upgraded algorithms and powerful attachments than AIS2000. It also gives more reliable testing results.

(1) Advanced H/W for user convenience and better repeatability

► Enhanced precision and data repeatability

AIS2100 made the following hardware improvements from AIS2000 for user satisfaction:

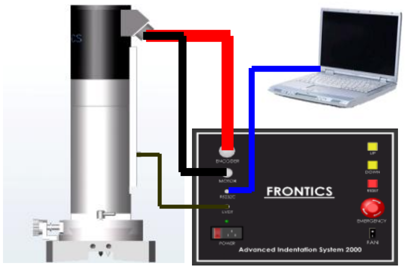
- High resolution
- Better data repeatability
- Stable data transmission (minimization of noise during data communications)

Model	AIS2000	AIS2100
Maximum load	300 kgf	300 kgf
Resolution (load/depth)	300 gf / 0.2 um	5.6 gf / 0.1 um
Data acquisition rate	10/sec	100/sec
Communication	RS-232C (serial port)	RS-422 (USB) / Wireless module

► Maximum portability

AIS2100 enhanced portability for better efficient in-field applications.

AIS2000	AIS2100
Main body Additional interface box Cable (3EA) Laptop PC (w/SW)	Main body **Interface module within main body** **Wireless module or 1 cable** Laptop PC (w/SW)



< AIS2000 hardware >

< AIS2100 hardware >

AIS2100 adds on items for quick and easy testing.

- Wireless communication module or one-line communication for system control
- Remote control function
- Direct system control and monitoring from LCD panel on top of main body
- Portable battery available (10 hr)

< Wireless communication >

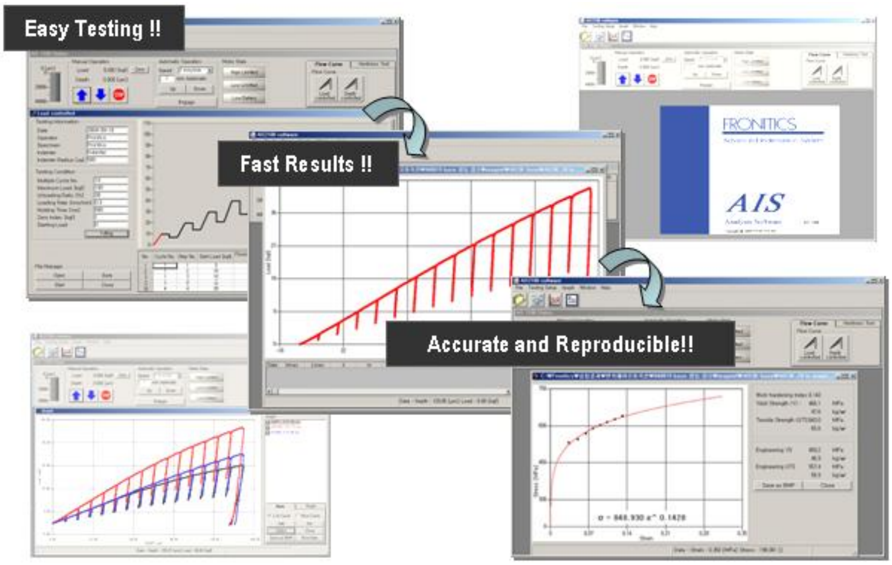
< Remote control and LCD >

< Portable battery >

(2) Easy software

► Maximum portability

- Accurate evaluation of tensile properties based on advanced indentation theory
- No reference test or data needed for tensile properties evaluation
- Convenient configuration of experiment conditions in SW
- Hardness evaluation available (Vickers)



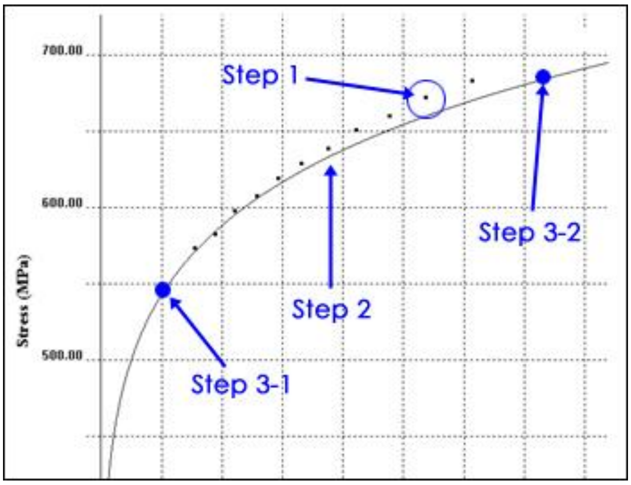
※ Comparisons of H/W specification: AIS2000 vs. AIS2100

<table>
<tr><th colspan="2">Model</th><th>AIS2000</th><th>AIS2100</th></tr>
<tr><td colspan="2">Size (weight)</td><td>180x180x470 mm (14 kg)</td><td>180x180x430 mm (14 kg)</td></tr>
<tr><td colspan="2">Maximum load</td><td>300 kgf</td><td>300 kgf</td></tr>
<tr><td colspan="2">Resolution
(load / depth)</td><td>300 gf / 0.2 um</td><td>5.6 gf / 0.1 um</td></tr>
<tr><td colspan="2">Full stroke</td><td>20 mm</td><td>40 mm</td></tr>
<tr><td colspan="2">Loading rate</td><td>0.1~6 mm/min</td><td>0.05~60 mm/min</td></tr>
<tr><td colspan="2">Communication</td><td>RS-232C</td><td>RS-422/ wireless module</td></tr>
<tr><td colspan="2">Data acquisition rate</td><td>10/sec</td><td>100/sec</td></tr>
<tr><td rowspan="2">Power</td><td>Adapter</td><td>AC 110 or 220V</td><td>AC 110~220V (free voltage)</td></tr>
<tr><td>Battery</td><td>none</td><td>Portable battery (10 hrs/ charge)</td></tr>
<tr><td rowspan="2">Analysis computer</td><td>Standard</td><td colspan="2">Laptop PC (w/SW)</td></tr>
<tr><td>Special</td><td colspan="2">Rugged computer (optional)</td></tr>
<tr><td colspan="2">Indenter</td><td colspan="2">WC spherical indenter
(dia. 0.5 / 1.0 mm)
Vickers, Rockwell C Indenter</td></tr>
<tr><td rowspan="2">Attachment tool (select or option)</td><td>Field</td><td>Multicurve magnet
Flat magnet
Lightweight mechanical chain
U / V-block (¾~6 inch)
dovetail slider</td><td>Multicurve magnet
Flat magnet
Lightweight mechanical chain
U -block (¾~6 inch)
Multi-point dovetail slider</td></tr>
<tr><td>Laboratory</td><td colspan="2">Precise X-Y axis stage
Various vises (plate/clamping jig)</td></tr>
</table>

(2) Upgraded S/W algorithms

AIS2100 has the revised S/W for more accurate and reliable data results:

- Revision of contact area determination procedure considering pile-up effect dependent on indentation depth and work-hardening characteristic of a material
- Revision of yield strength determination procedure based on indentation-derived elastic modulus



Step 0 Determination of **contact area**

$$\mathbf{a \rightarrow a_c}$$

Step 1 Derivation of **stress-strain points**

$$\sigma = \frac{L}{\pi a^2}\frac{1}{\psi}, \quad \varepsilon = \frac{\alpha}{\sqrt{1-(a/R)^2}}\frac{a}{R} = \alpha \tan\gamma$$

Step 2 Determination of **flow curve**

$\sigma = K\varepsilon^n$ for BCC-type materials

$\sigma = A\varepsilon^{n_1} + B$ for FCC-type materials

Step 3 Determination of **yield strength** (3-1) and **tensile strength** (3-2)

$\sigma_y = K(\varepsilon_y + b)^n$ yield strength

$\sigma_{UTS} = Kn^n$ tensile strength

2. Testing result comparison (GE specimens) : AIS2000 and AIS2100

► Testing result Comparison

Tensile data by GE				AIS2000 data				AIS2100 data			
Grade	ID	YS (MPa)	UTS (MPa)	Frontics YS (MPa)	Frontics UTS (MPa)	Frontics YS - Error(%) / STD	Frontics UTS - Error(%) / STD	Frontics YS (MPa)	Frontics UTS (MPa)	Frontics YS - Error(%) / STD	Frontics UTS - Error(%) / STD
B	**20 144 5**	**312**	**466**	**380**	**484**	**22(18.5)**	**4(8.3)**	**308**	**482**	**-1(15.3)**	**3(3.7)**
	20 105 9	**322**	**467**	**351**	**453**	**9(5.8)**	**-3(5.6)**	**310**	**463**	**-4(12.8)**	**-1(11.5)**
	20 139 22	**349**	**464**	**345**	**451**	**-1(9.6)**	**-3(2.4)**	**325**	**471**	**-7(3.8)**	**2(1.5)**
X52	20 112 11	384	525	409	519	7(6.81)	-1(3.9)	414	544	8(7.1)	4(3.2)
	20 106 9	402	511	388	510	-4(7.05)	0(4)	411	529	2(7.2)	4(3.4)
	20 165 7	422	486	385	484	-9(7.89)	0(3.8)	423	504	0(7)	4(8)
X60	16 75 5	426	532	385	507	-10(10.65)	-5(3.9)	406	531	-5(9.8)	0(6.1)
	16 76 8	459	564	413	516	-10(9.54)	-9(3.7)	442	548	-4(9.6)	-3(4.1)
X70	19 34 8	479	587	469	557	-2(6.95)	-5(6.8)	501	616	5(24.4)	5(2.7)
	19 40 6	501	596	464	579	-7(13.89)	-3(9.4)	488	613	-3(10.9)	3(4.5)