

**INTRODUCTION of
SAIJO FACTORY &**

Coke Drum Technology

Rio de Janeiro, August 2009

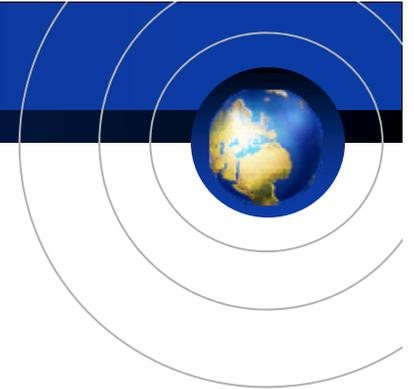


Sumitomo Heavy Industries, Ltd.

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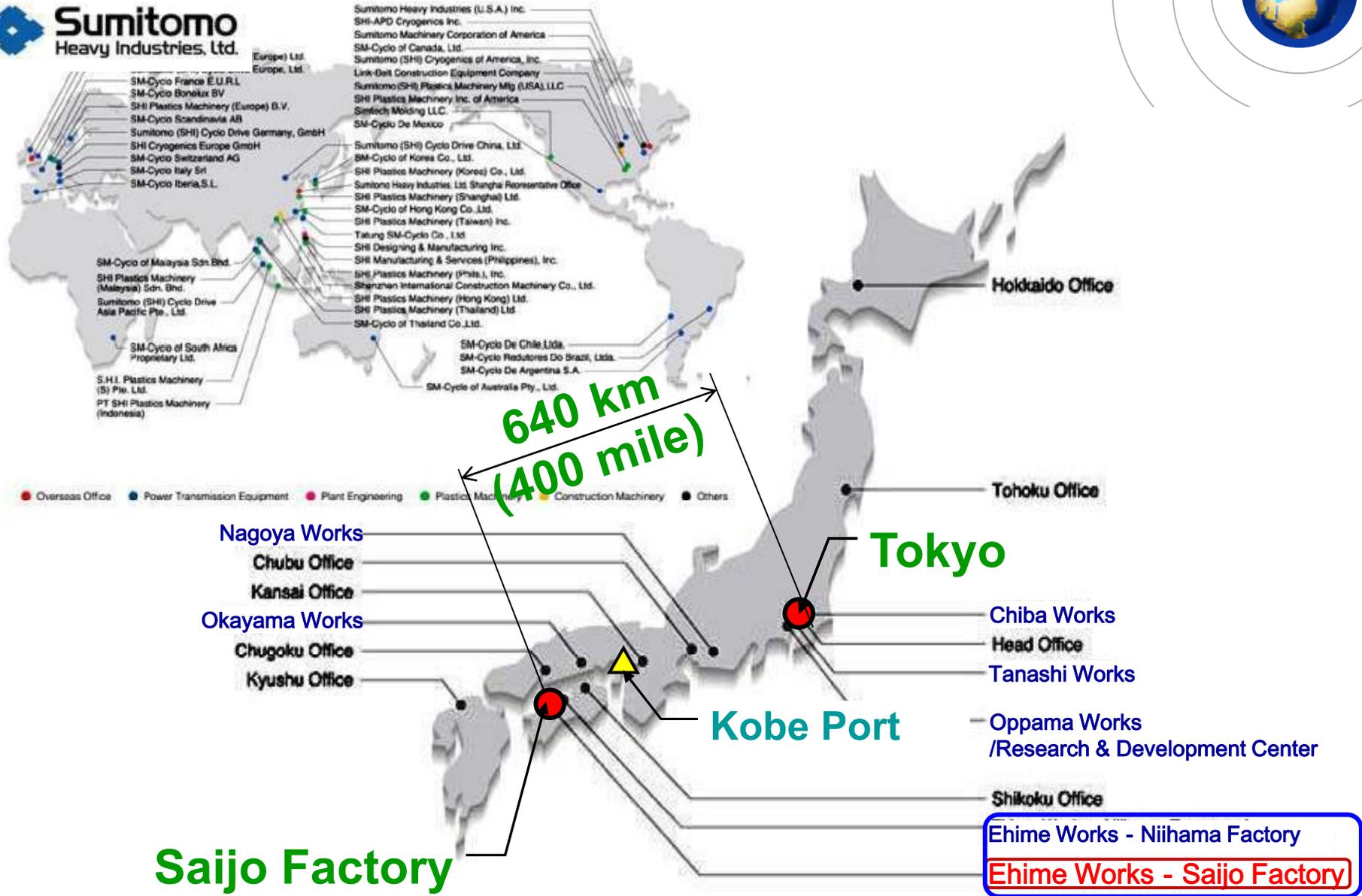
- 1. SAIJO Factory Profile**
- 2. Experience & Capability**
- 3. Cutting Edge Techniques**
- 4. Research & Development**



1. SAIJO Factory Profile

- **Location**
- **History**
- **Brief Introduction**

SAIJO Factory Profile : Location



SAIJO Factory Profile : History



1973 Established as a manufacturing base for large steel products

1974 Obtained U & U2 Stamps of ASME



1984 Attained 100 unit ASME Stamped Products

1989 Concentrated on Reactors and Coke Drums

1993 Obtained ISO 9001 certificate



1996 Concentrated on Coke Drum Manufacturing

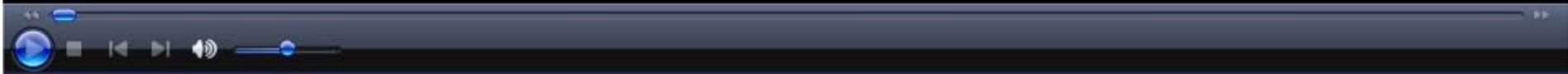
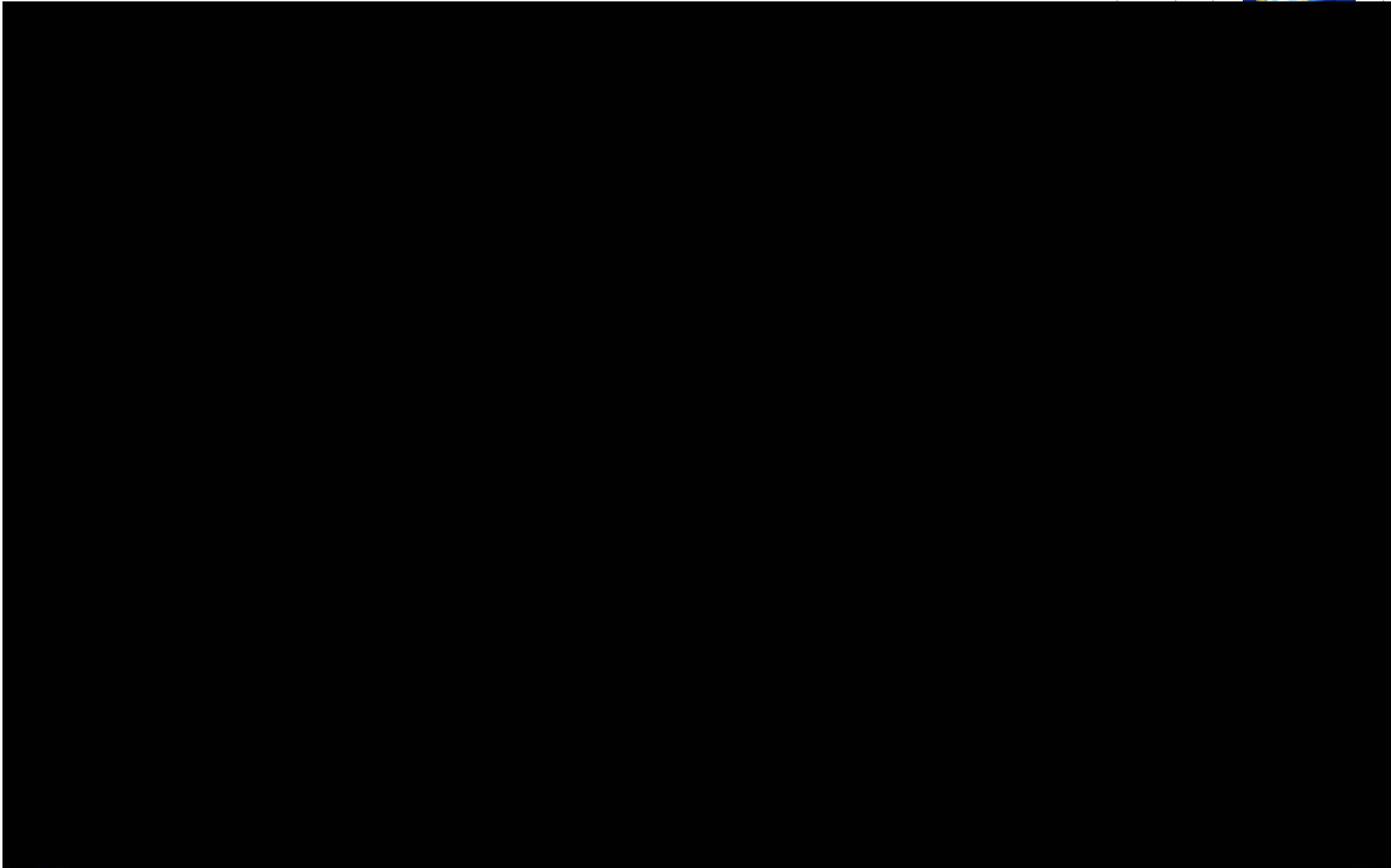
1999 Obtained ISO 14001 certificate

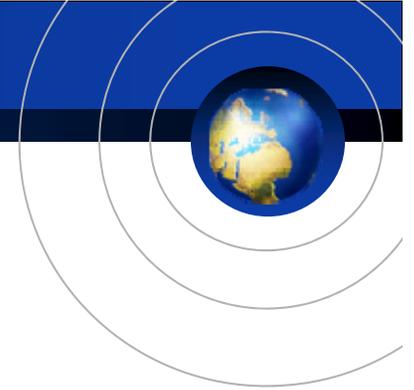


2006 Fabricated 100th Coke Drum

2009 Total Coke Drums Awarded Since 1973 = 176!

SAIJO Factory Profile : Brief Introduction





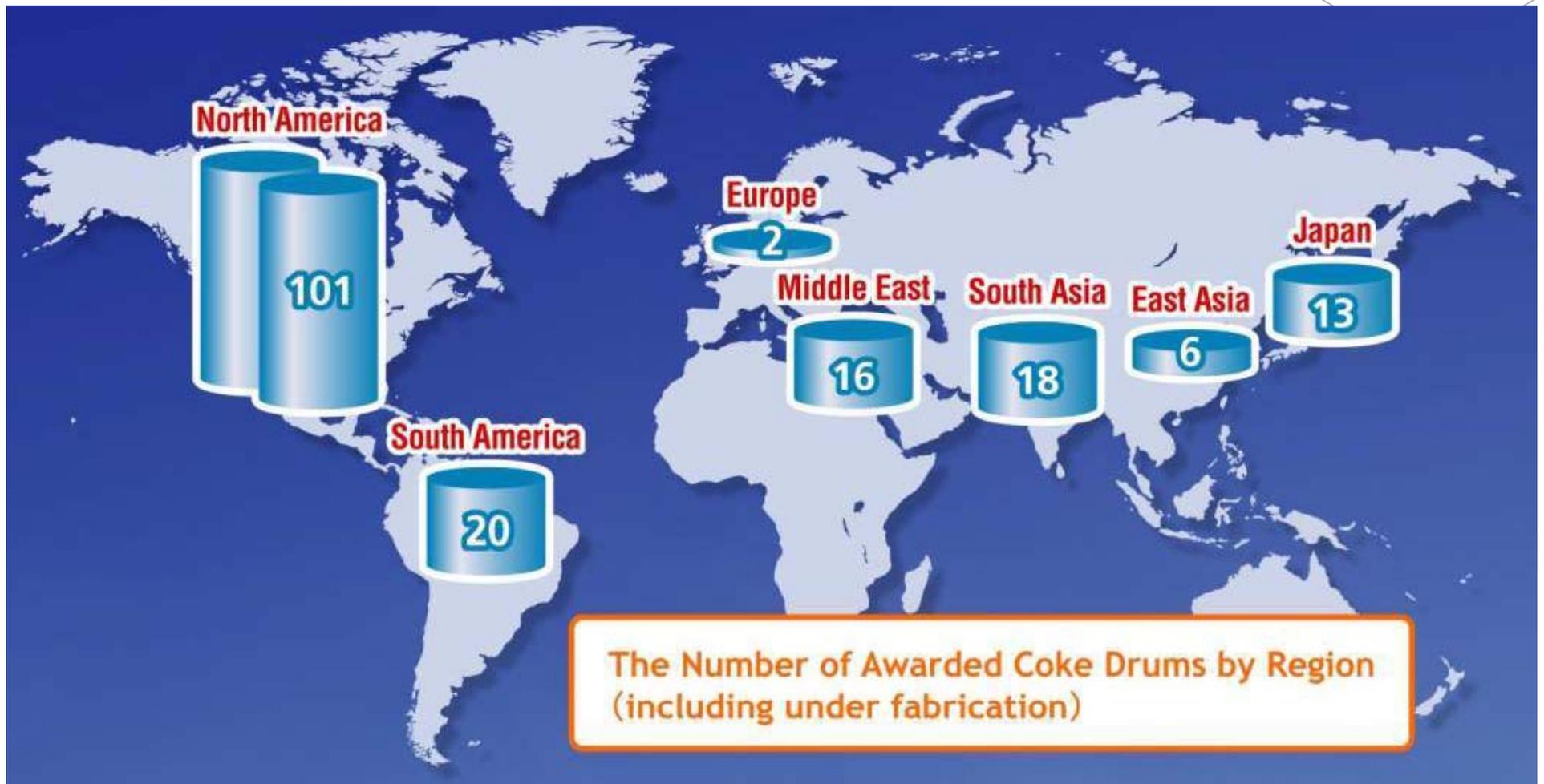
2. Experience & Capability

- **World-wide Delivery**
- **Coke Drum Weight & Size**
- **Materials**
- **Strict Quality Assurance**
- **Site Assembly**
- **Field Inspection Services**

Experience & Capability : World-wide Delivery



176 Coke Drums Delivered Throughout the World

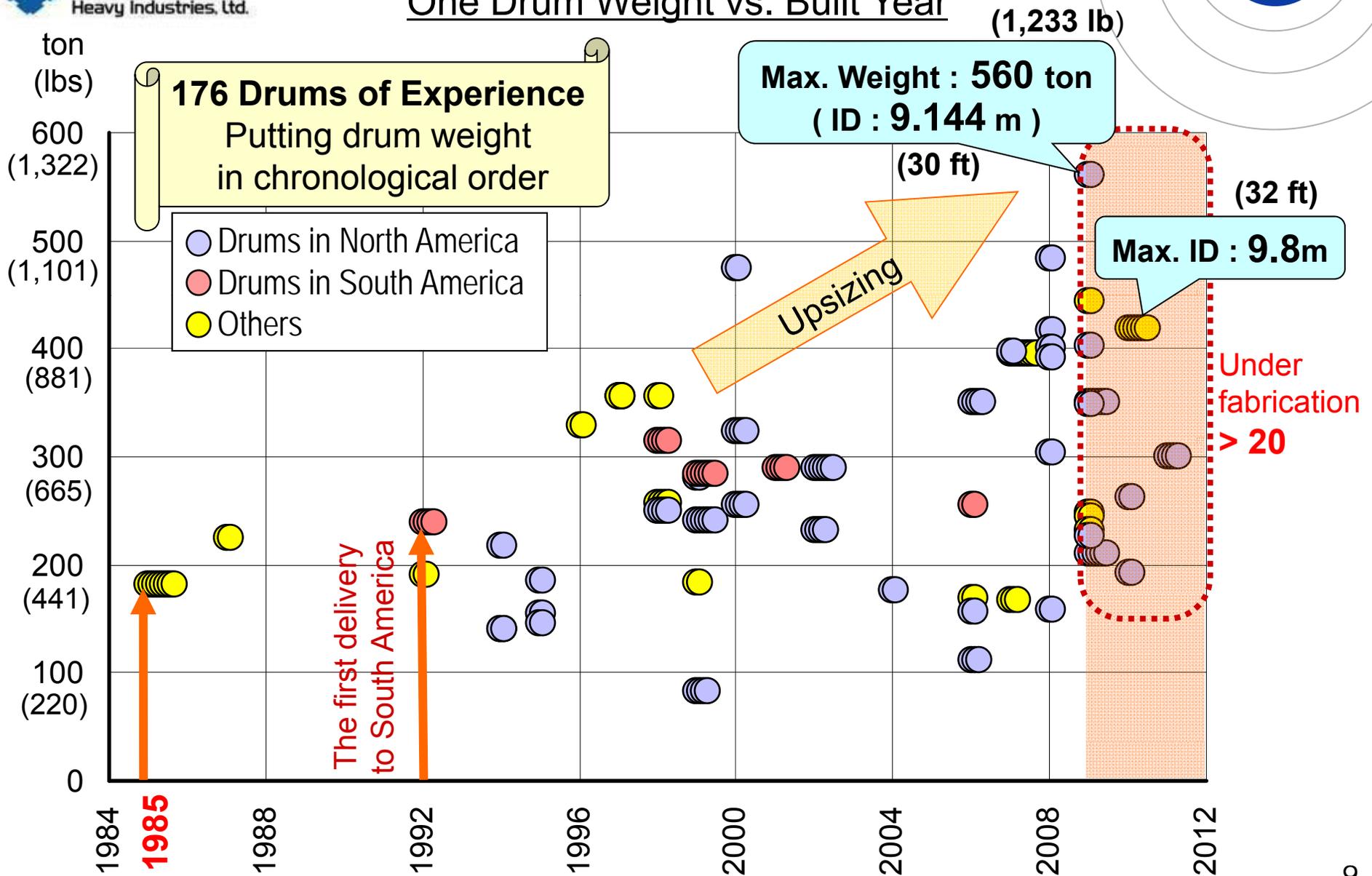


(As of May 2009)

Experience & Capability : Coke Drum Weight & Size



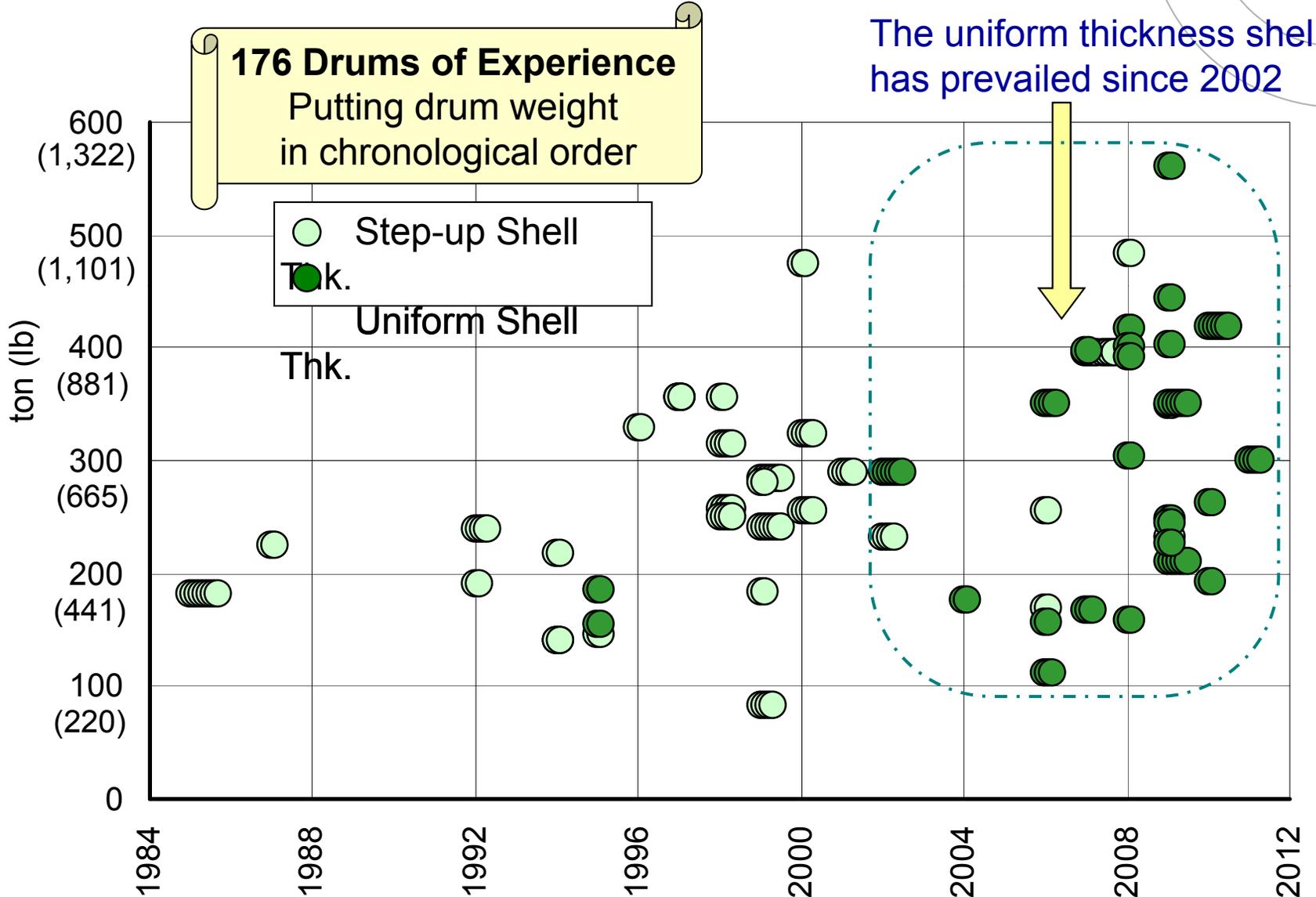
One Drum Weight vs. Built Year



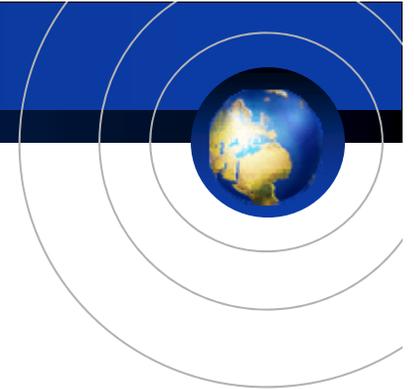
Experience & Capability : Coke Drum Weight & Size



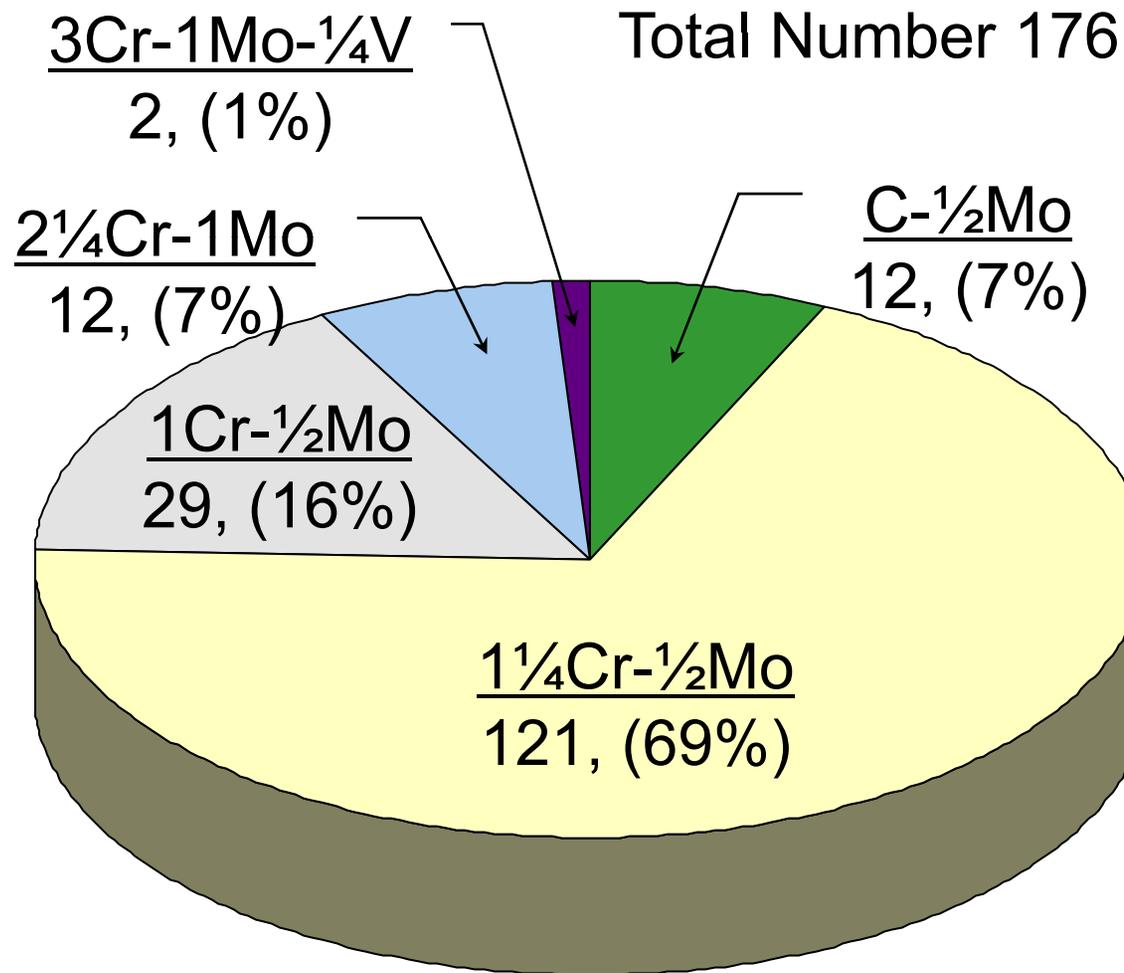
One Drum Weight vs. Built Year



Experience & Capability : Materials



Fabrication Experiences of Coke Drums for Individual Base Materials



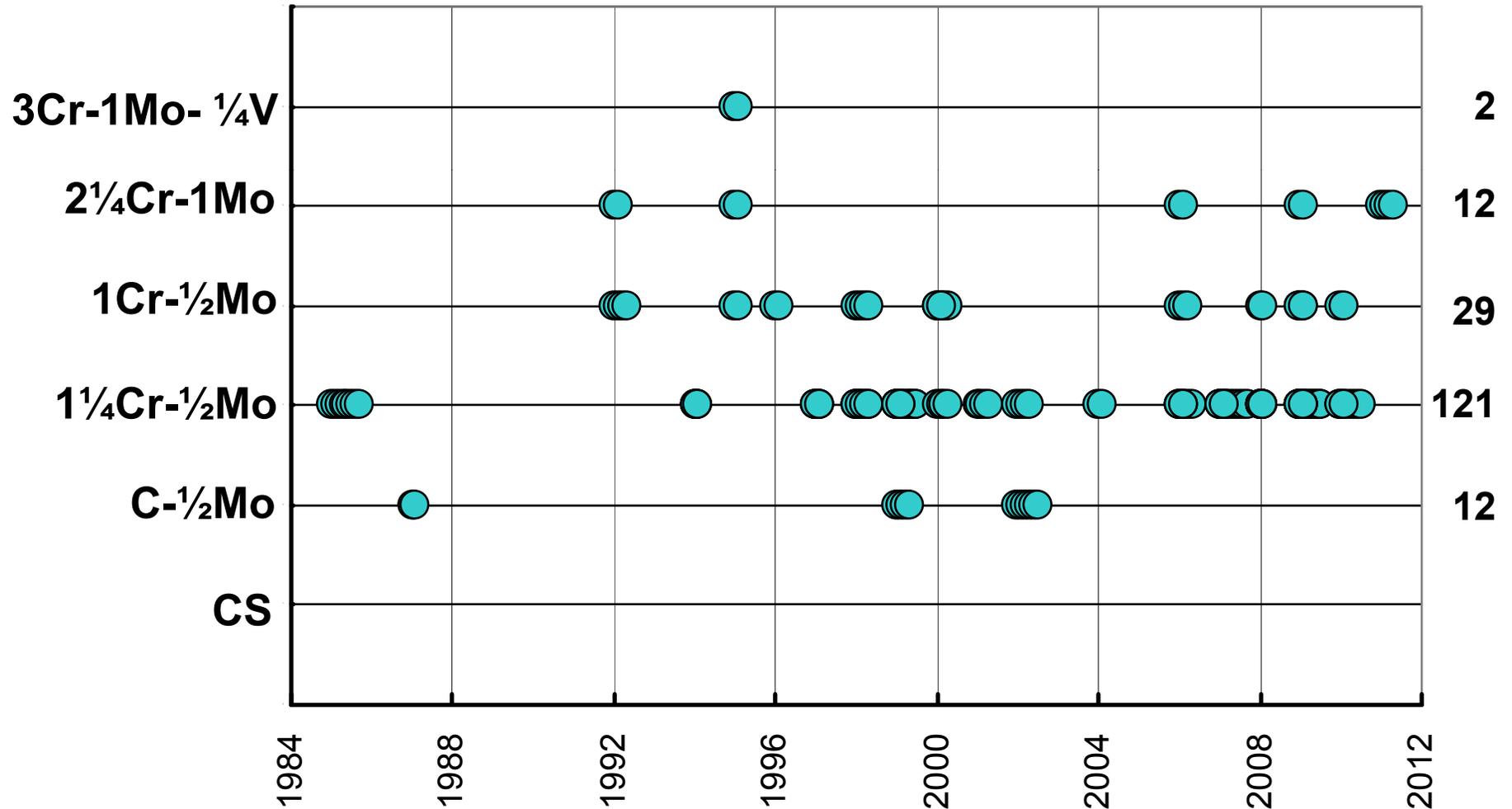
Experience & Capability : Materials



Chronological Fabrication Experiences of Coke Drums for Individual Base Materials



Total Number 176



Experience & Capability : Strict Quality Assurance



Skilled Welders

Solid Performance Anywhere



Honing their skills through the training program



ASME Qualified Welders: Over 120

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Experience & Capability : Site Assembly



Assembling Experience in South America

Shipping



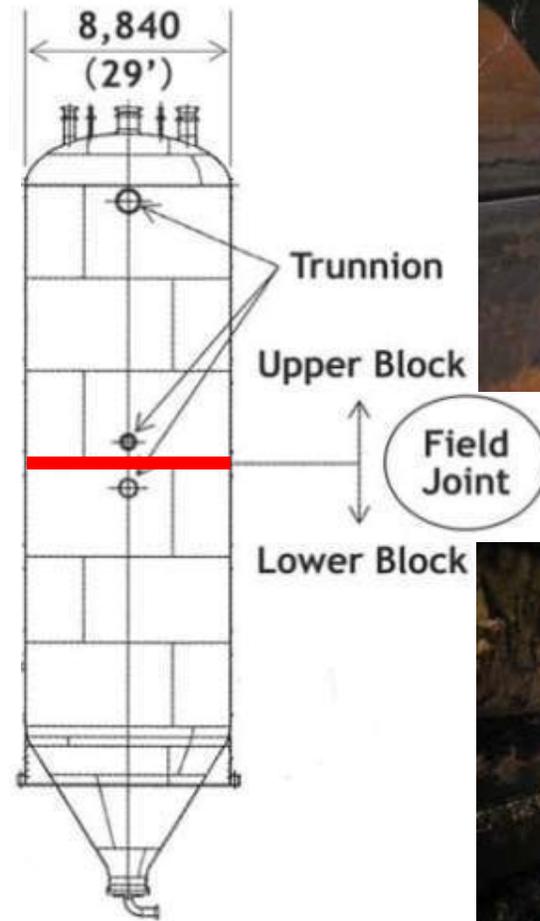
Fit-up



* Surface Transportation



* Erection



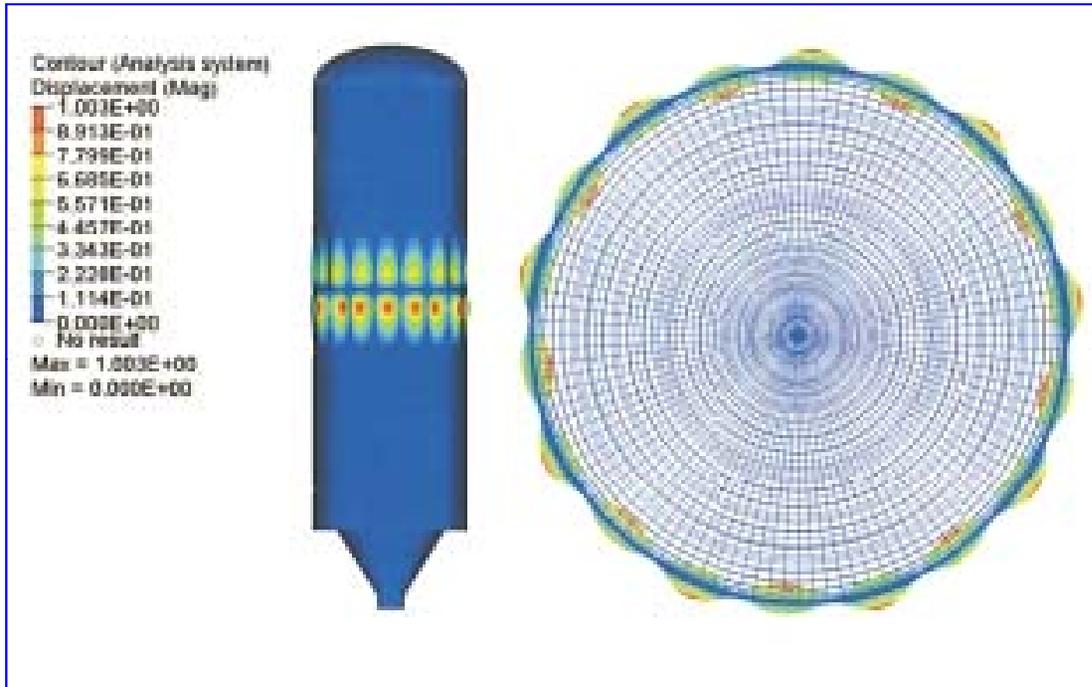
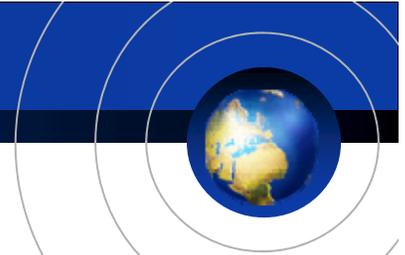
Field Welding

* Both processes are out of Sumitomo's scope

Experience & Capability : Site Assembly

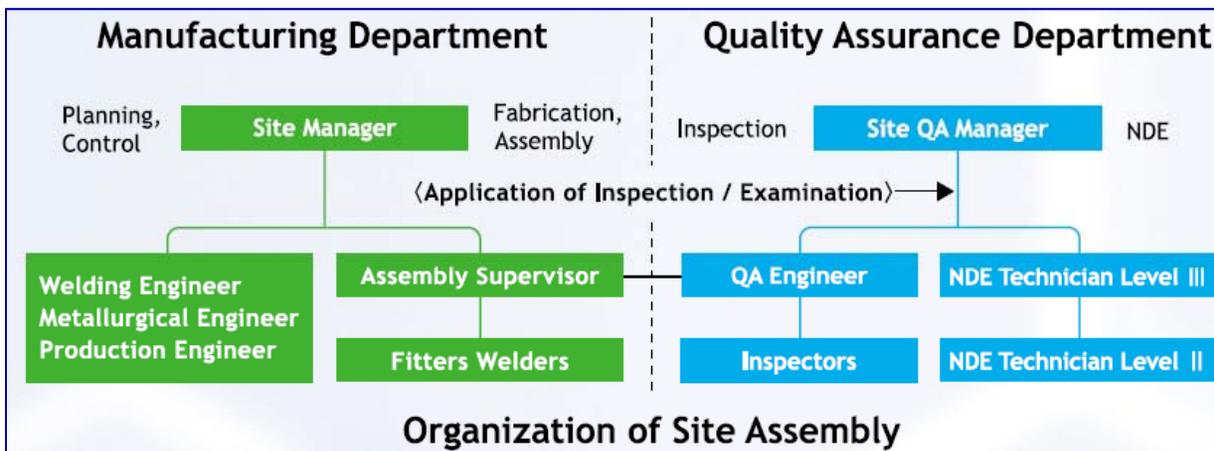


Assembling Experience in South America



The great extent of our capabilities for a site assembly

Ex.-1)
Buckling analysis verification taking the reduction in the material properties due to PWHT on site and the field weld groove fit-up condition into consideration



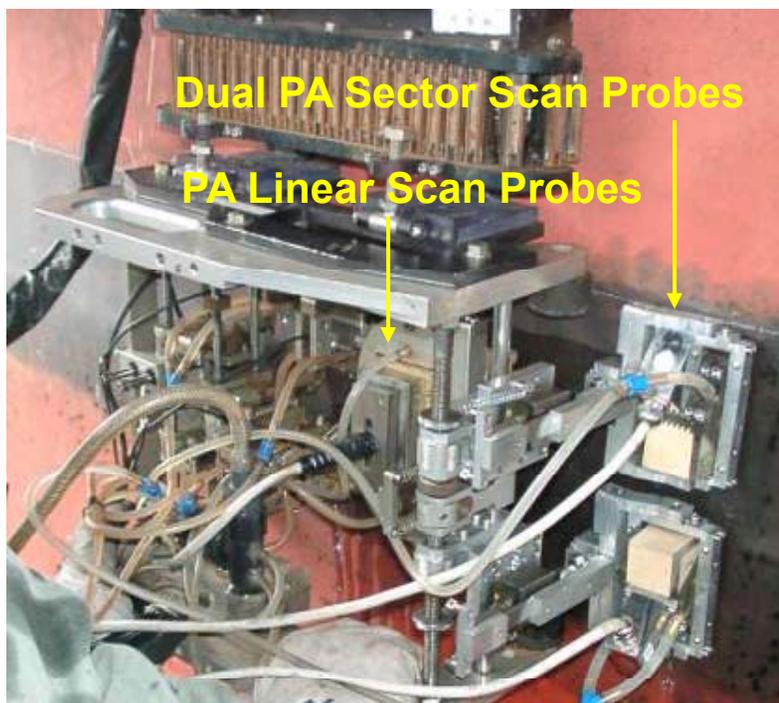
Ex.-2)
Applied organization to meet "ASME Field Assembly"

Experience & Capability : Field Inspection Services



In-Service AUT Inspection for Coke Drum

- Dual PA Sector Scan (by using 2 PA Probes) and Dual TOFD Simultaneous Inspection System
- Detection and Accurate Height Sizing by Phased Array for Fatigue Cracks in the Clad Restoration Weld and its Heat Affected Zone



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Experience & Capability : Field Inspection Services



In-Service AUT Inspection for Coke Drum

TOFD Automatic Ultrasonic Testing for Condition Monitoring of Coke Drums

Simultaneous Acquisition and Analysis for the Flaw Propagation Monitoring by Phased Array and TOFD

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2003 ASME Pressure Vessels & Piping Conference



Contribution to ASME PVP 2003 by PDVSA & S.H.I.EI

PVP-Vol. 468, Aging Management and Component Analysis
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UTIC ULTRASONIC TESTING FOR CONDITION MONITORING OF COKE DRUMS

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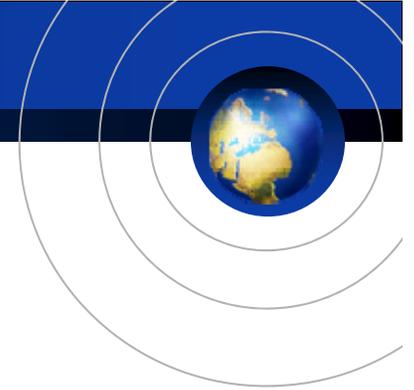
KEYWORDS: Coke drums, ultrasonic, monitoring, cracks, time of flight diffraction, Phased Array

ABSTRACT

Cracking and bulging in welded and internally lined pressure vessels that work in thermal-mechanical cycling

The inspection methodology in combination with fracture mechanics was used to classify discontinuities as acceptable and non-acceptable. This indicated approach helped to optimize the workscope during the turnaround and establish guidelines for inspection and repair of the delayed coker unit. This work presents the different steps followed during the inspection and

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3. Cutting Edge Techniques

■ Integral Skirt Fabrication

To bring longer fatigue life by utilizing Sumitomo's large scale facilities

■ Automatic Devices

To achieve high-level productivities and quality

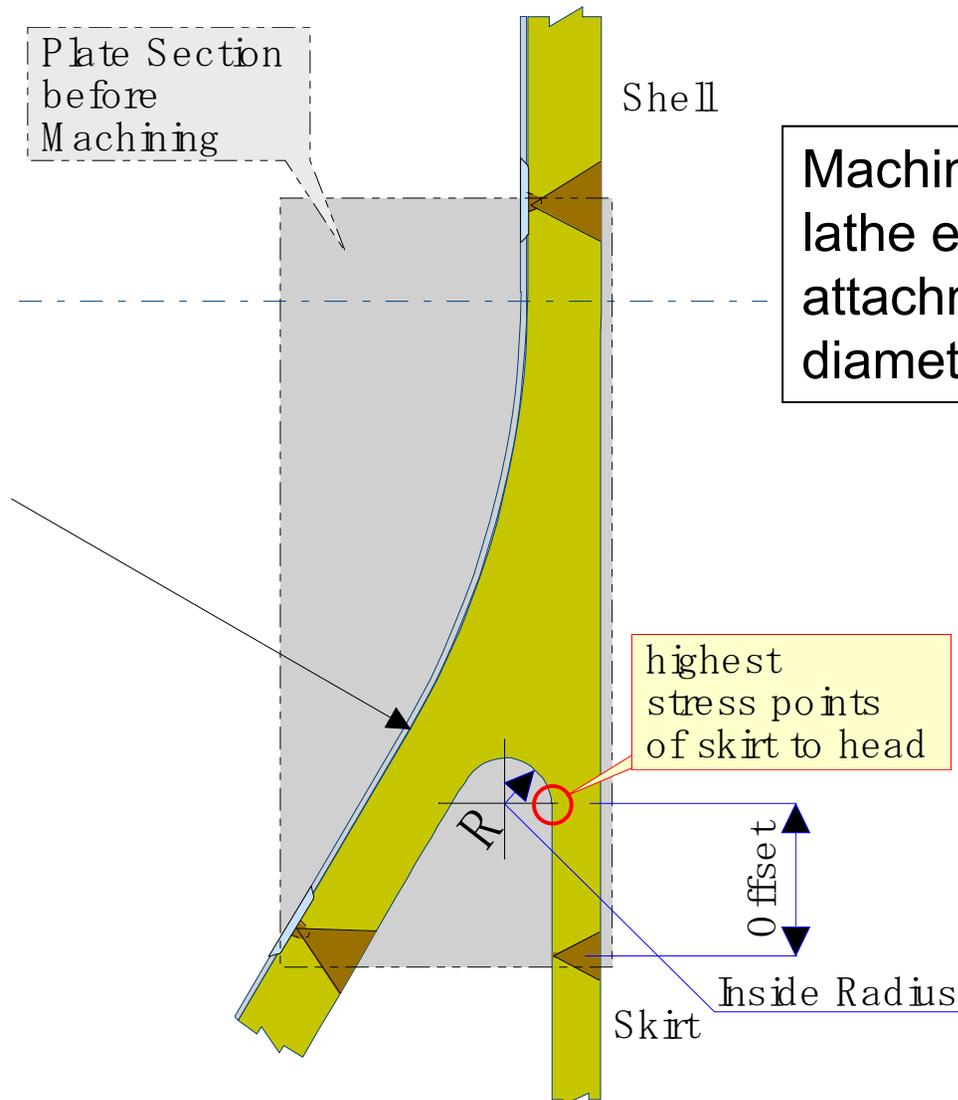
■ Production Process Control

To meet short delivery times and customer requests

Cutting Edge Techniques : Integral Skirt Fabrication



Integral Skirt Attachment Design



Machining by the large scale vertical lathe enable us to manufacture the skirt attachment portion up to the coke drum diameter 12m(39ft).

Advantage

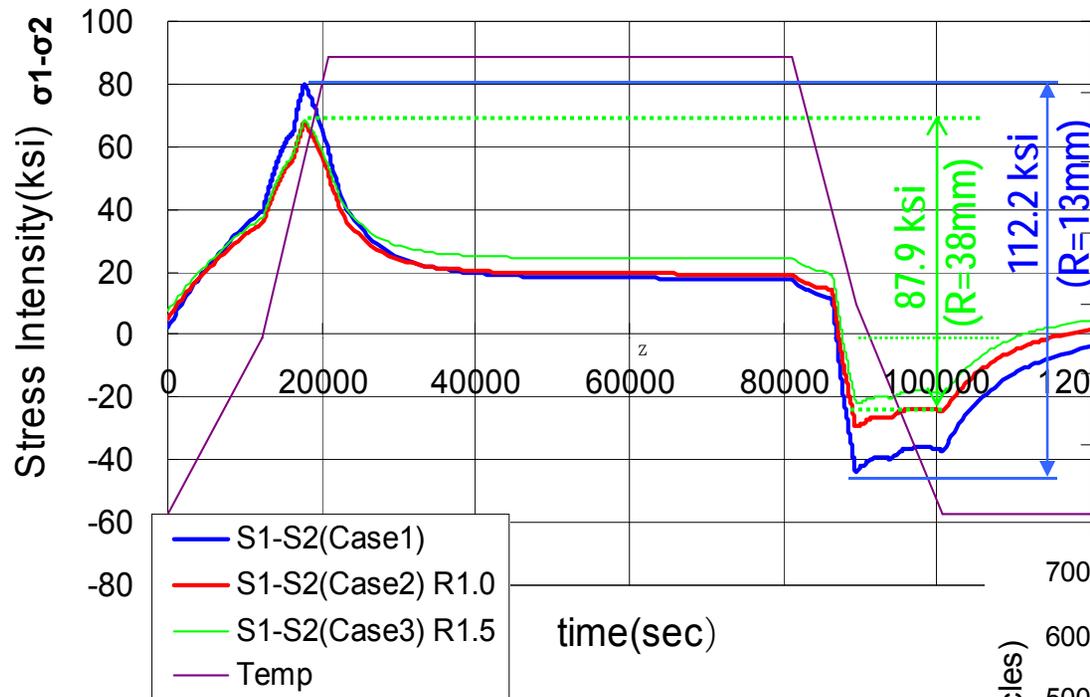
- To make a large r inside radius
【R = 38^{mm}(1.5") - 50^{mm}(2")】
- No circumferential welds joint at highest stress point of skirt to head

Cutting Edge Techniques : Integral Skirt Fabrication

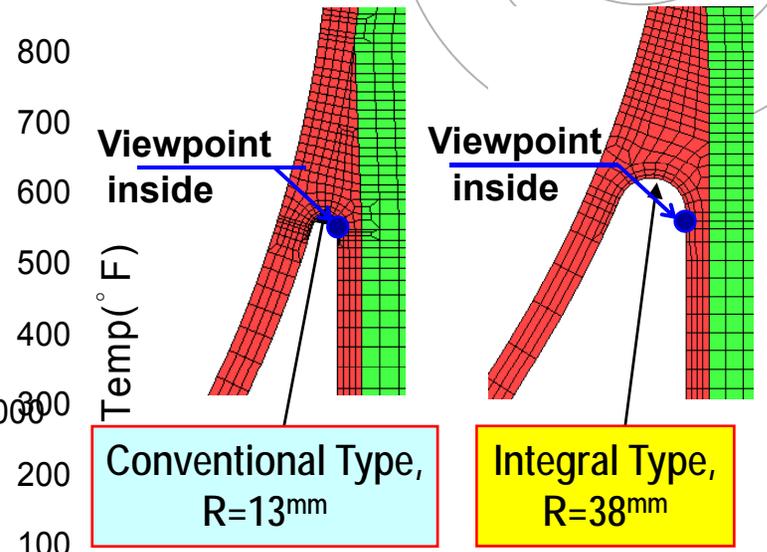


Effect on Stress Intensity Range & Fatigue Life

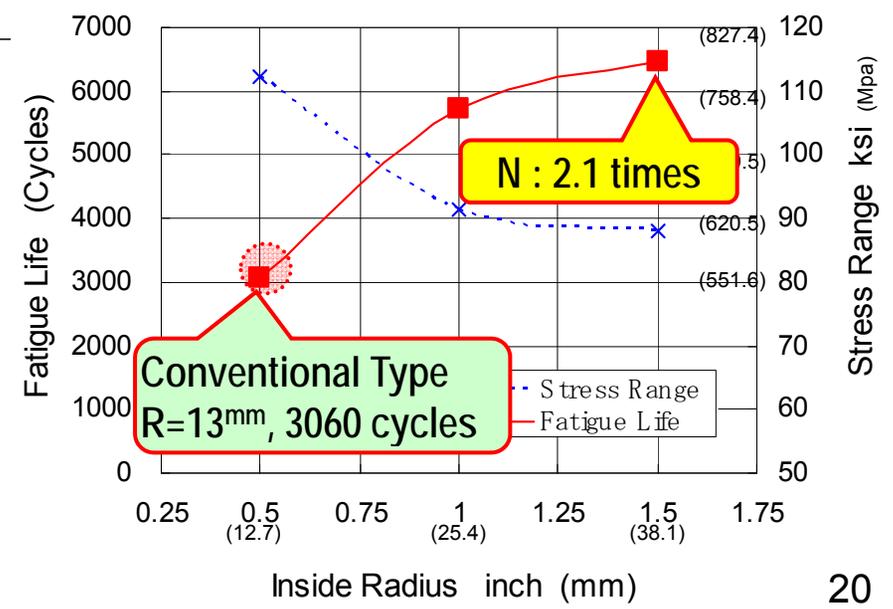
(Comparison Example)



Principal Stress difference Vs. Time



- “Stress Intensity Range” can be reduced to about **80%** level by enlarging the inside radius from 13mm to 38mm.
- The fatigue life can be extended to about **2 times** by enlarging the inside radius.



Cutting Edge Techniques : Integral Skirt Fabrication



Fabrication Experience of the Integral Skirt

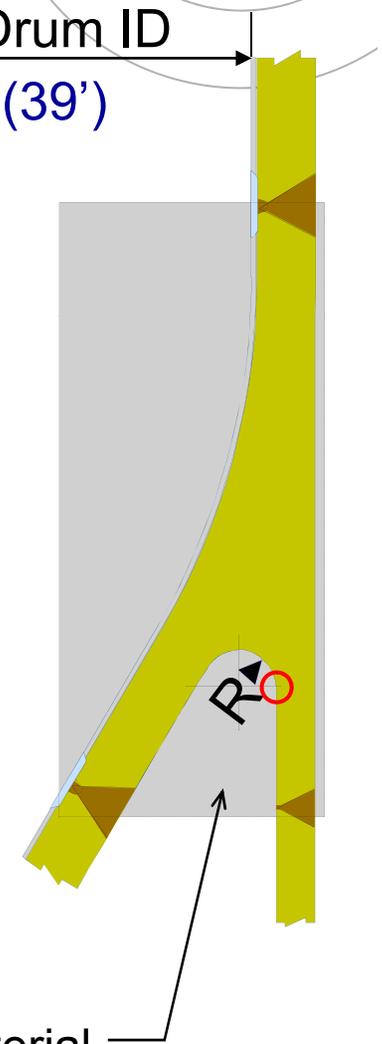
Drum ID

Applicable Max. ID = 12,000mm (39')

Built Year	Drums	Drum ID	Inside Radius of the Skirt Attachment
1992	2	7,620 mm (25')	20 mm (0.8")
2002	6	8,484 mm (27.8')	35 mm (1-3/8")
2006	2	6,400 mm (21')	30 mm (1-1/8")
2007	3	6,100 mm (20')	25 mm (1")
2009	2	7,620 mm (25')	30 mm (1-1/8")
2009	2	6,400 mm (21')	30 mm (1-1/8")
(2010)	2	6,096 mm (20')	35 mm (1-3/8")

Σ19

Original Rectangular Material



Cutting Edge Techniques : Automatic Devices

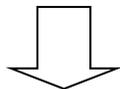


Surface Finish of Welds with Special Machine

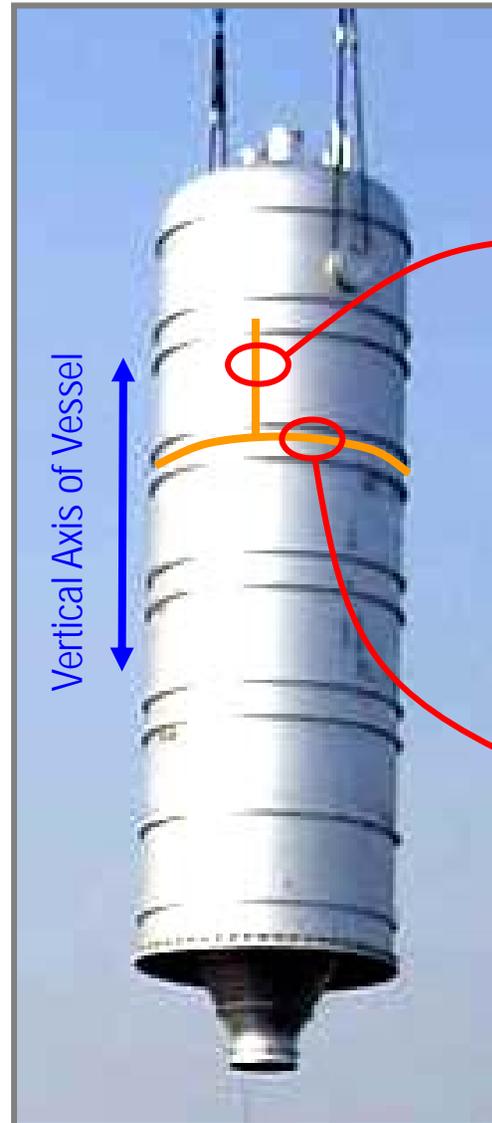


Typical Requirements for Surface Finish of Weld

- Ground smooth & flush both outside and inside the shell
- Grinding indication direction below top T.L. to be arranged parallel with the vertical axis of the Vessel
- Roughness of weld surface to meets some specific value (Ex. Max.125 μ inRa)



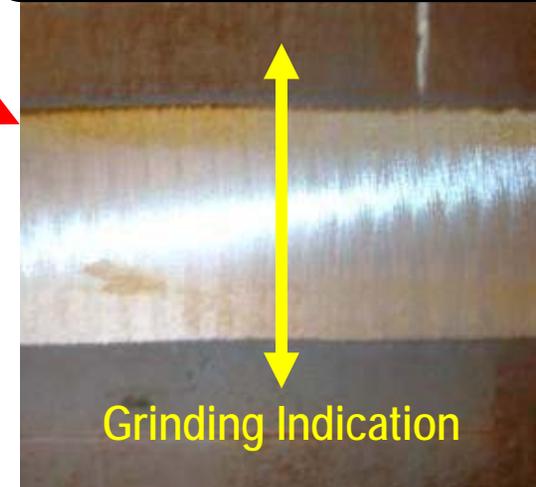
Sumitomo has been developing grinding machines to satisfy the customer requirements for the surface finish of welds.



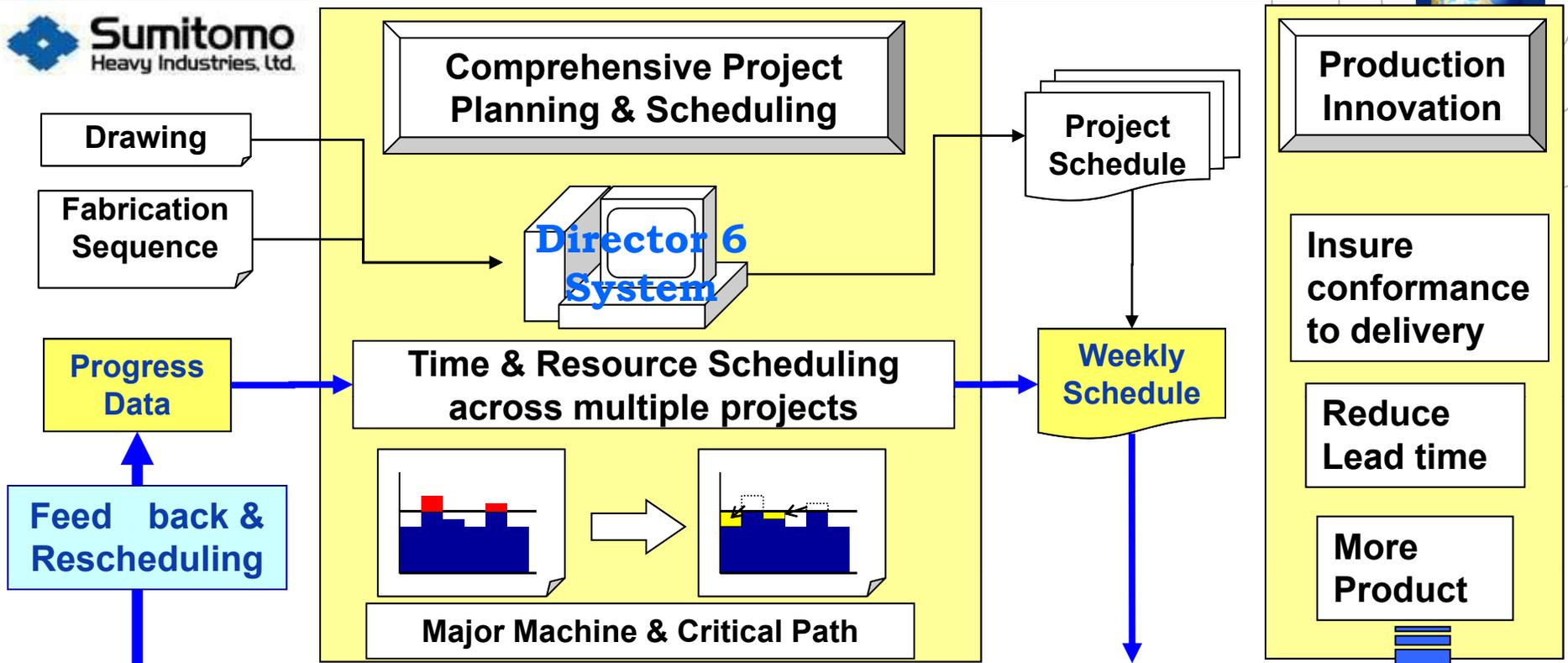
Longitudinal seam



Circumferential seam



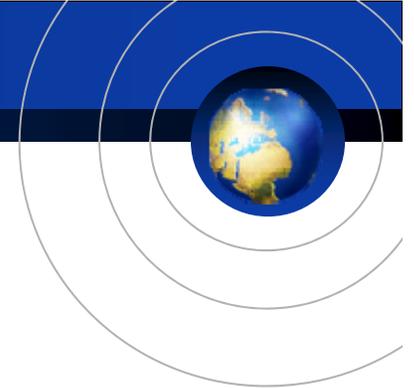
Cutting Edge Techniques : Production Process Control



Work Processes



Progress Daily Check Board at each area in the shop



4. Research & Development

■ Skirt Attachment Examination

To establish innovative skirt structures by the experiment

■ Improvement in Welding Material

(Strength Matching of Welding Metal)

To help shell to less bulge by controlling the weld metal strength

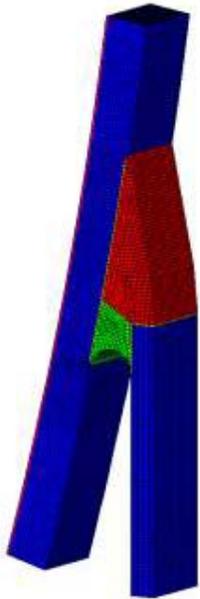
R&D : Skirt Attachment Examination



Static Loading Test and Thermal Test



FEA Modeling

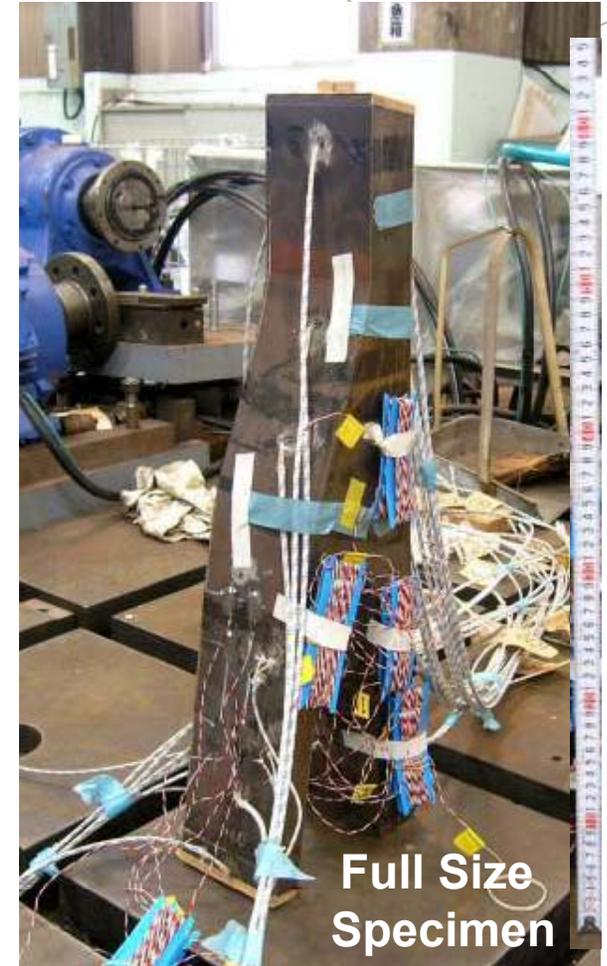


Static loading test



Full Size Specimen

Thermal test



Full Size Specimen

Thermocouple & high temperature strain gauge

- **Actual** strength measurement based upon various experiments
(Static, Thermal and Fatigue)
- **More Accurate** FEA Study verified by the experimental data

R&D : Skirt Attachment Examination

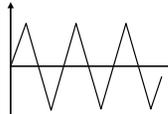


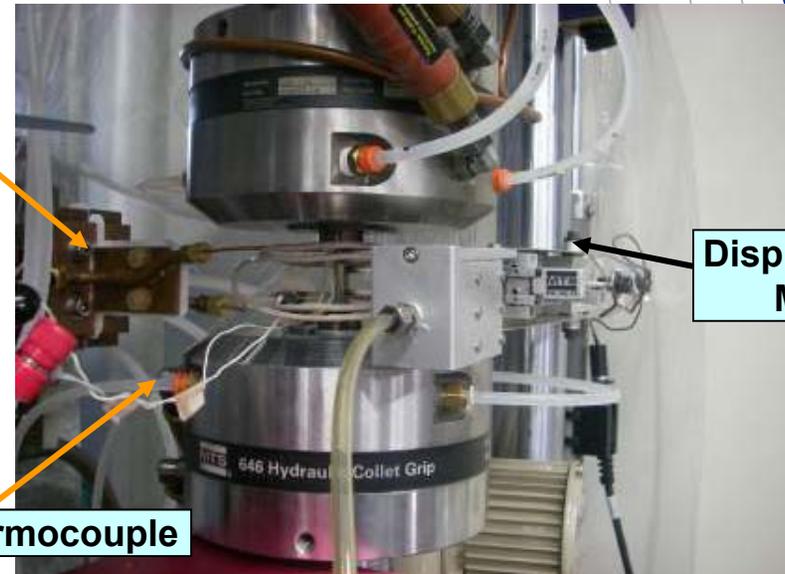
Fatigue Test

Materials

➤ 1¼Cr-½Mo

Test Condition

Waveform 	Strain control ; under zero mean strain Waveform ; triangular
Temperature	RT, 500°C (932°F)
Strain rate (S ⁻¹)	10 ⁻³



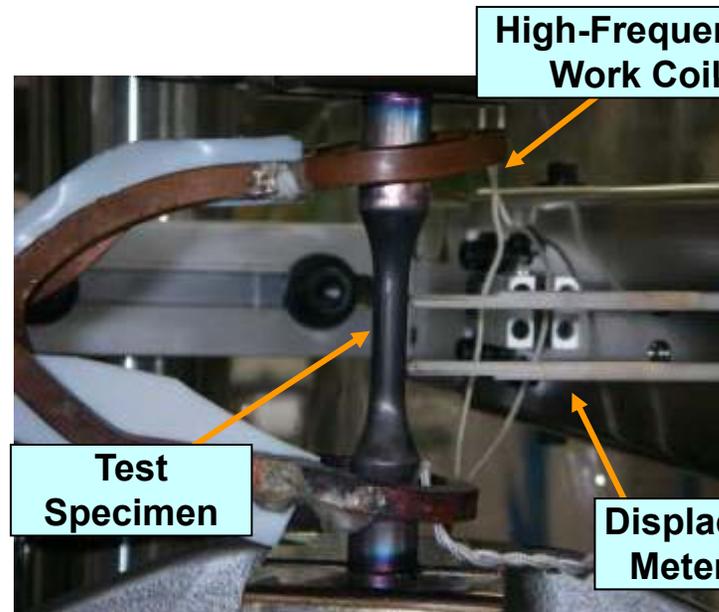
High-Frequency Heating System

Displacement Meter

Thermocouple



R.T. Test



High-Frequency Work Coil

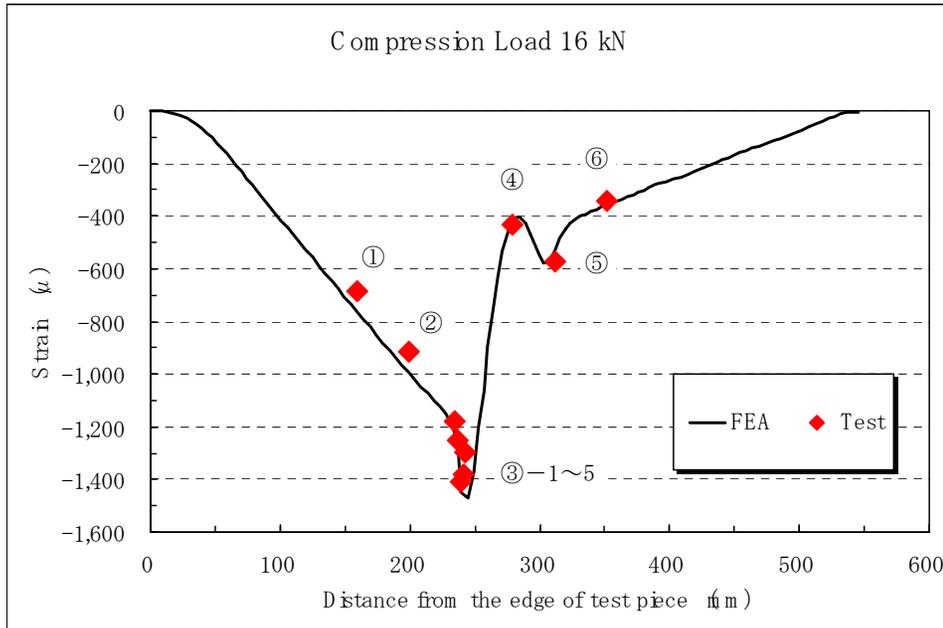
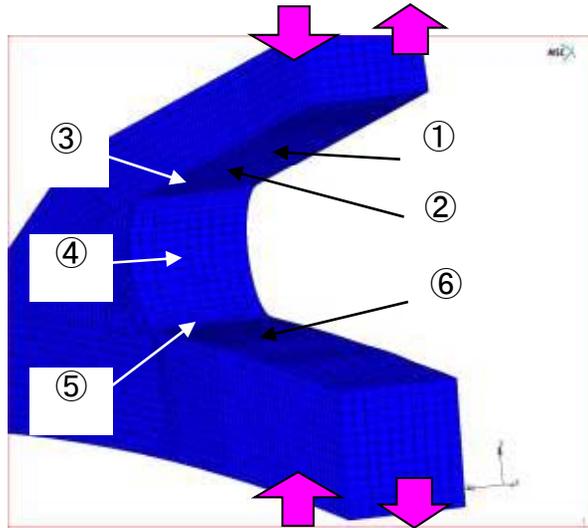
Test Specimen

Displacement Meter Chip

500°C(932°F) Test

R&D : Skirt Attachment Examination

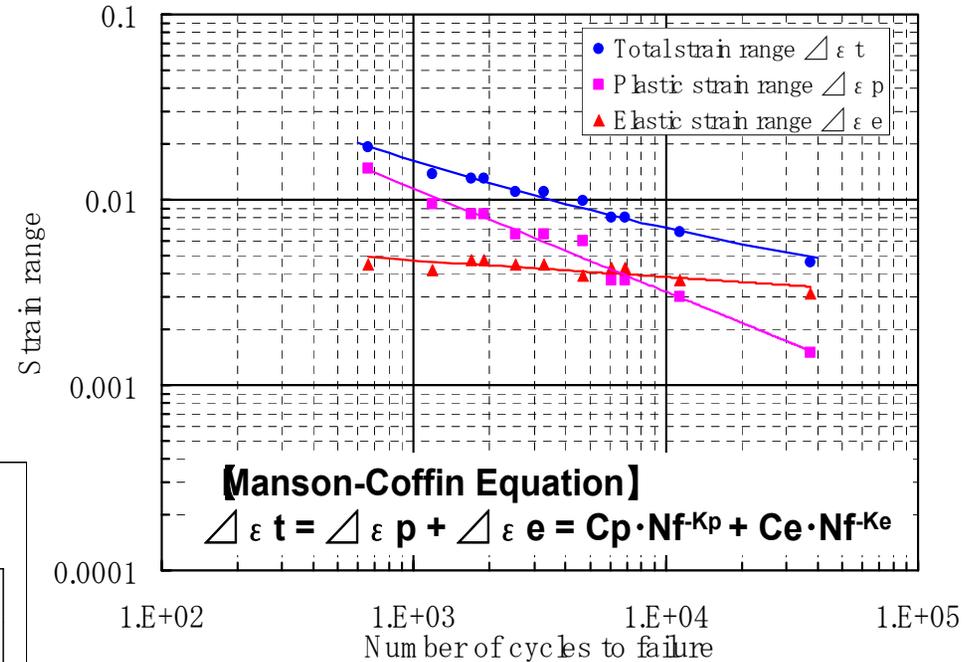
Static loading test verification of FEA



Setting for fatigue curve

Tested at room temperature

Strain Rate ; 10^{-3}



Test Condition

<p>Waveform</p>	<p>Strain control ; under zero mean strain Waveform ; triangular</p>
<p>Strain rate (S^{-1})</p>	<p>10^{-3}</p>

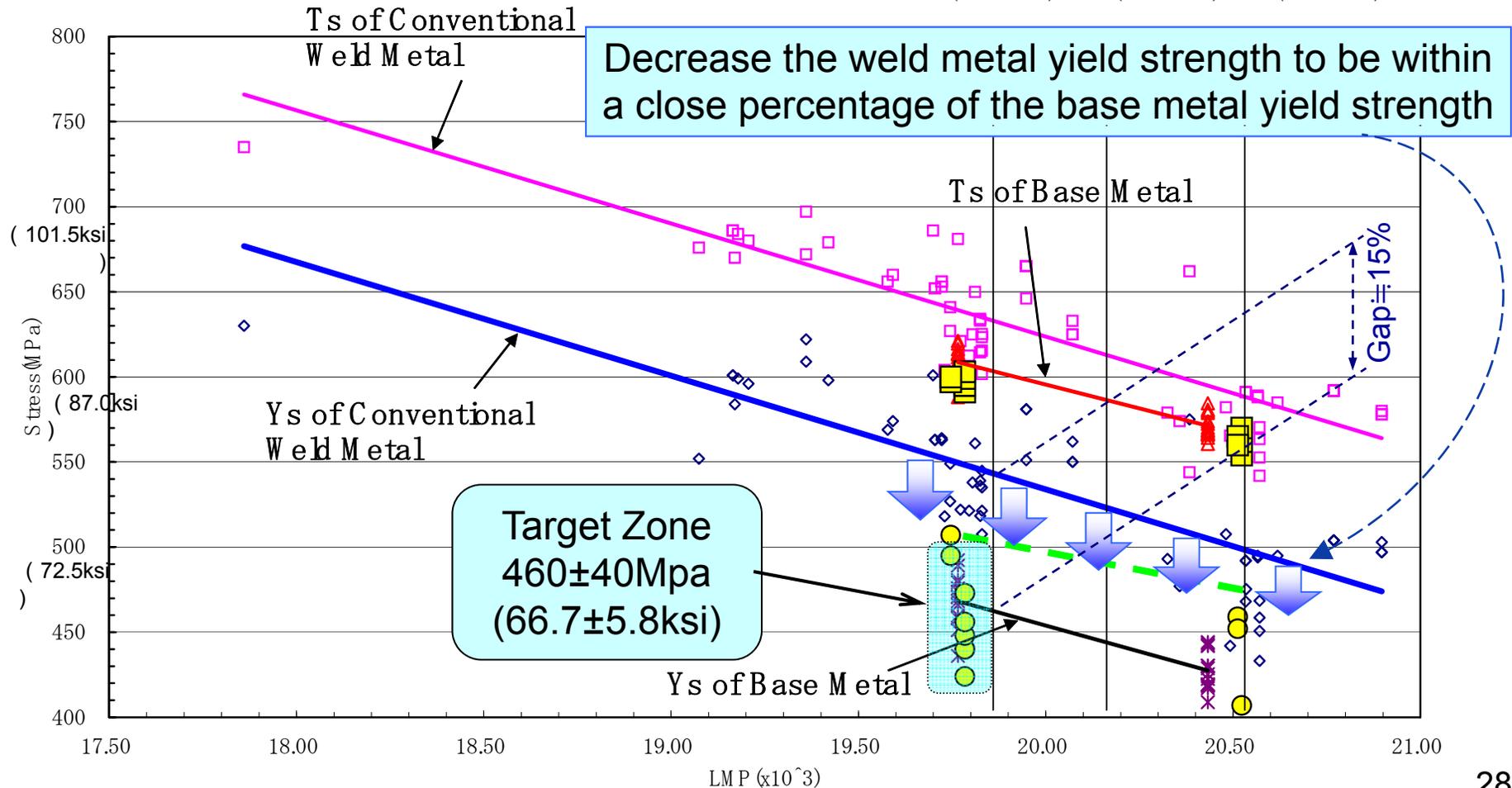
R&D : Improvement in Welding Material



Developed welding materials for 1¼Cr-½Mo to lower the yield strength of the weld metal to lower the yield strength of the weld metal

- :Ts of Weld Metal after Improvement
- :Ys of Weld Metal after Improvement

690°C × 4Hrs (LMP 19.83) 690°C × 8Hrs (LMP 20.13) 690°C × 20Hrs (LMP 20.51)





Questions Welcomed

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FAX: 81-3-6866-5123

<http://cokedrum.shi.co.jp:8080/index.php>



Thank You!



Sumitomo Heavy Industries, Ltd.