

## KAWASAKI STEEL TECHNICAL REPORT

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### A New Process for Manufacturing Deep-Drawing Cold-Rolled Steel Sheets from Extra-Low-Carbon Steels

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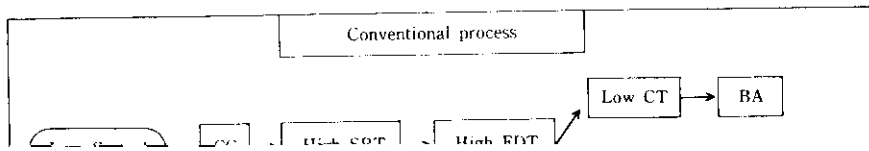
#### Synopsis :

For developing a new process of manufacturing deep-drawing cold-rolled steel sheets, effects of chemical composition and hot-rolling conditions on mechanical properties of extra-low-carbon steel sheets have been investigated. The results obtained are given below: (1) In low C content less than 0.002%, resistance to aging can be obtained without overaging treatment in continuous annealing. However, improvement of deep-drawability by lowering C content is small because planar anisotropy of mechanical properties is extremely large. (2) A small addition of Ti or Nb effectively decreases the planar anisotropy and gives good deep-drawability. (3) Lowering a slab reheating temperature below 1100 °C in such steels provides good deep-drawability even for hot-rolling with the finishing temperature below Ar<sub>3</sub> and the coiling temperature below 600 °C. This is noticeable in Ti-added extra-low-carbon steels. (4) On the basis of g<sub>c3</sub>carbon sid-r

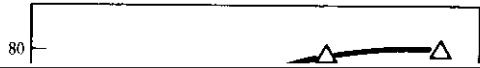
## A New Process for Manufacturing Deep-Drawing

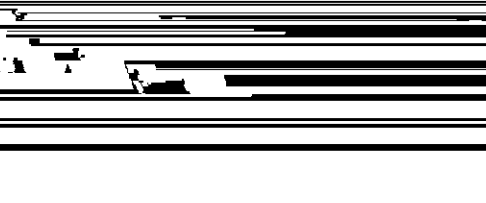
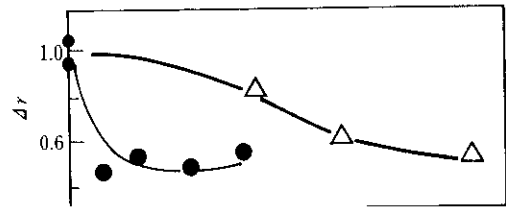
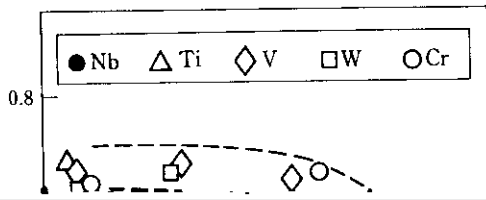
## Extra-Low-Carbon Steels<sup>\*1</sup>

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degassing-refining techniques, is remarkable, and it has now become possible to economically produce extra-low-carbon steels with C contents of 0.005% or less.

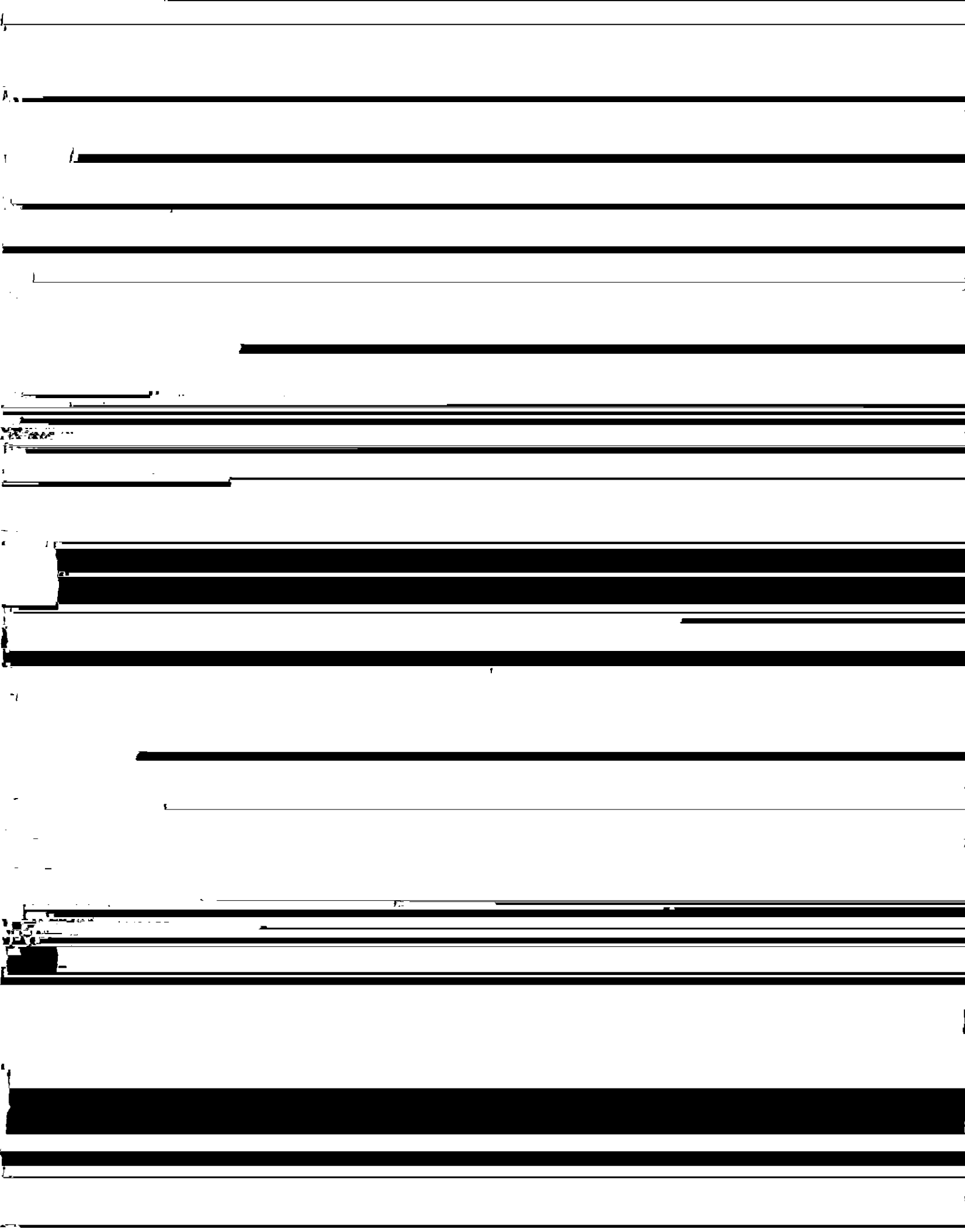




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reduced by addition of Nb or Ti.

Figure 7 schematically shows a comparison between



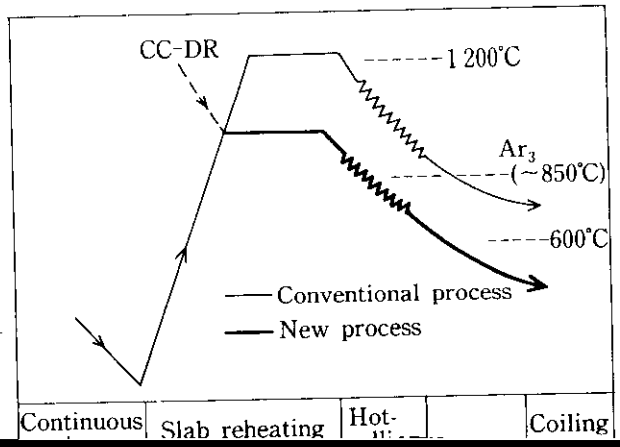
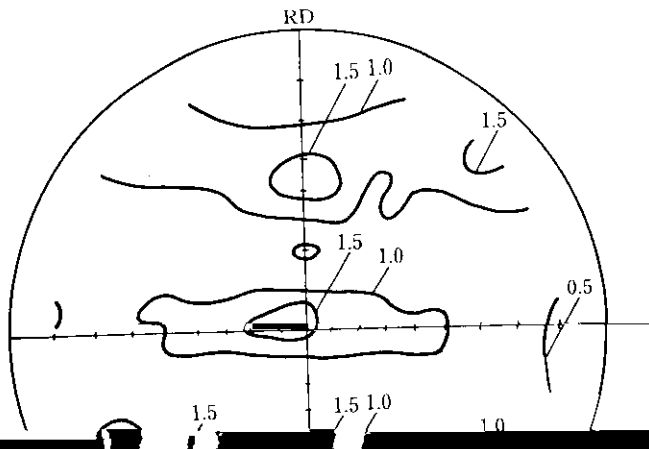


0.002%C-- 0.010%Nb	0.002%C-- 0.032%Ti (Ti* = 0.006%)
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reheating is great in Ti-added steels.

The relationship between low-temperature hot rolling ( $FDT < Ar_3$ ) and deep-drawability will now be discussed. To produce cold-rolled steel sheets excellent in deep-drawability (high  $r$ -values), the general practice has been to finish hot rolling at temperatures above  $Ar_3$ .





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