

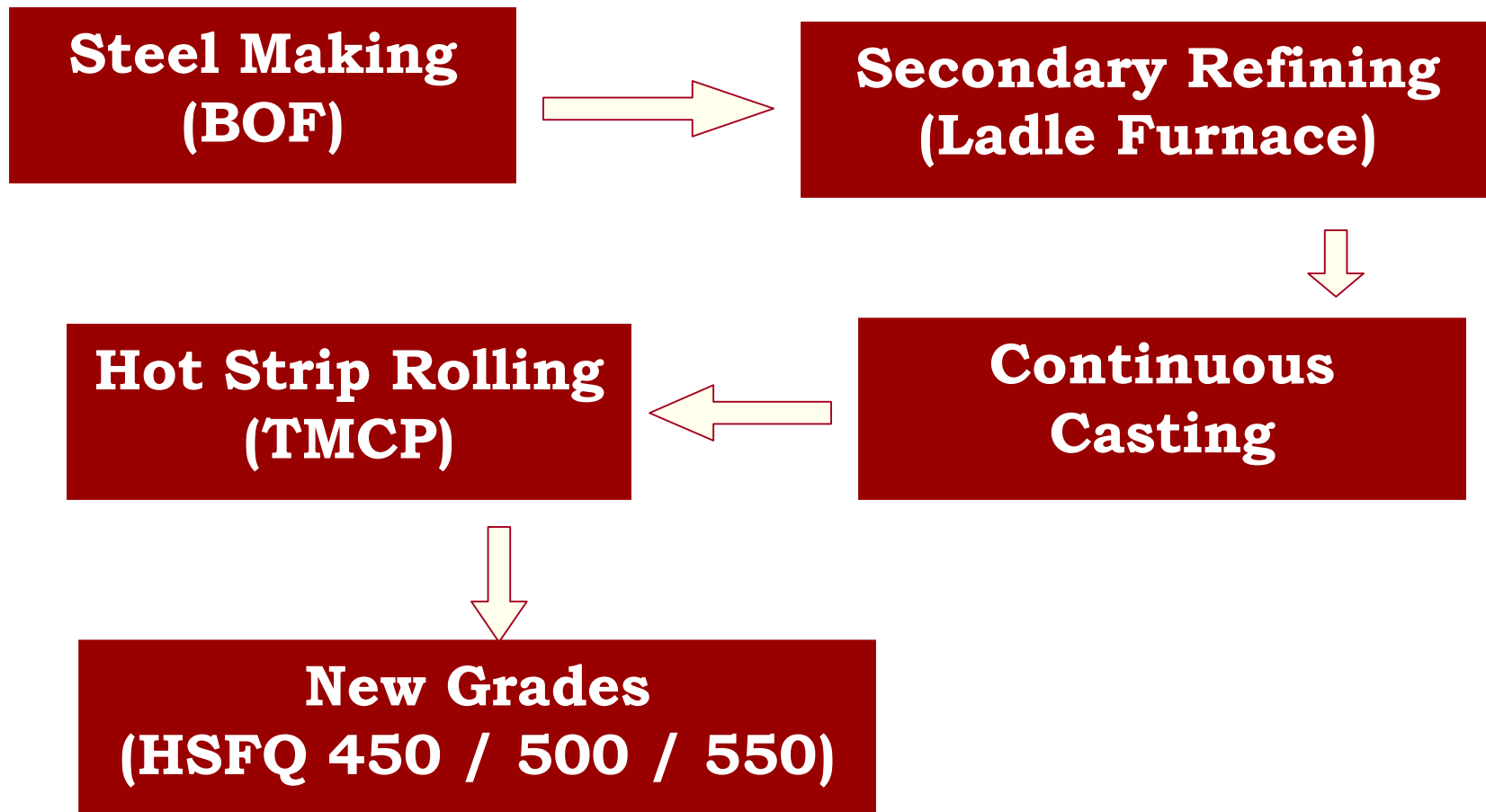
Hot rolled formable grades from SAIL: Present status and future trends



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Process Route

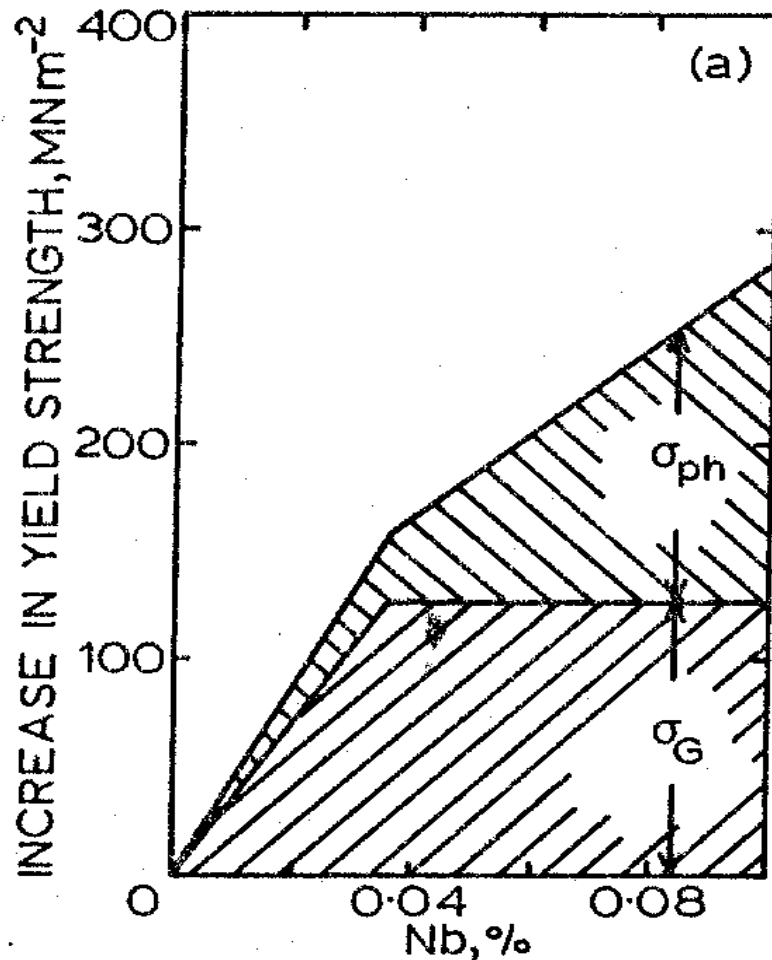


Product characteristics

- High Strength and toughness
- Formability
- Cleanliness
- Weldability

Achieved through innovative alloy design with
higher Si and lower Nb

Limitation of Existing High Strength Hot Rolled Grades



- Higher YS achieved by Nb addition
- Si restriction < 0.05 %

High YS/UTS > 0.92

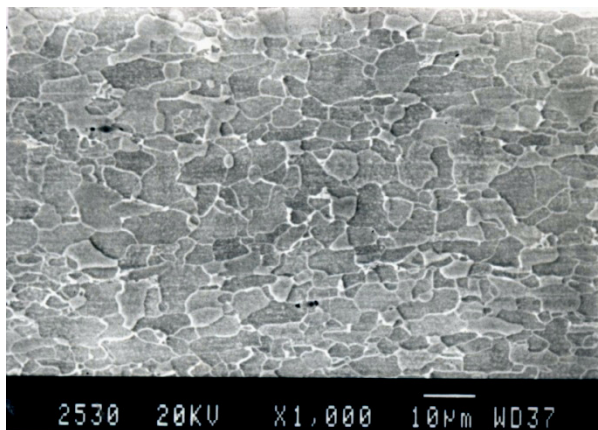
High strength Formable Quality (HSFQ) steel (BSL)

- Series of HSFQ grades (HSFQ 450/500/550) developed with innovative alloy design

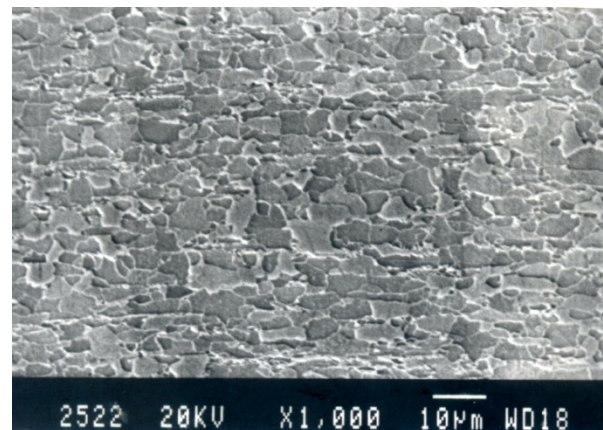
Nb (0.025-0.045 %) and Si (0.25-0.35%)

- All round improvement in formability with Reduced cost of production

- **HSFQ 450** (lower YS/UTS : 0.86 max, Higher % El: 32 and Higher Hole Expansion : 150 % min)



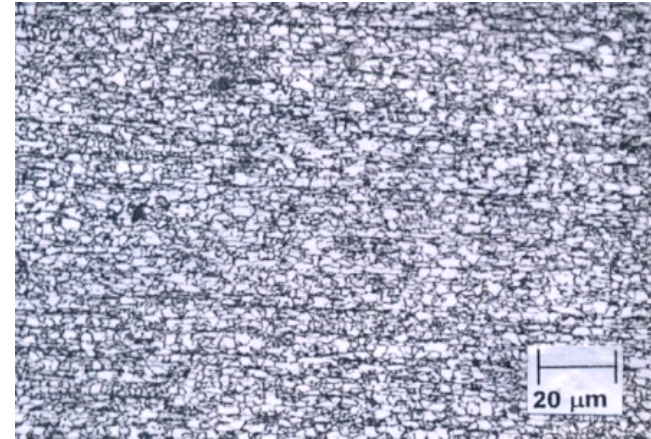
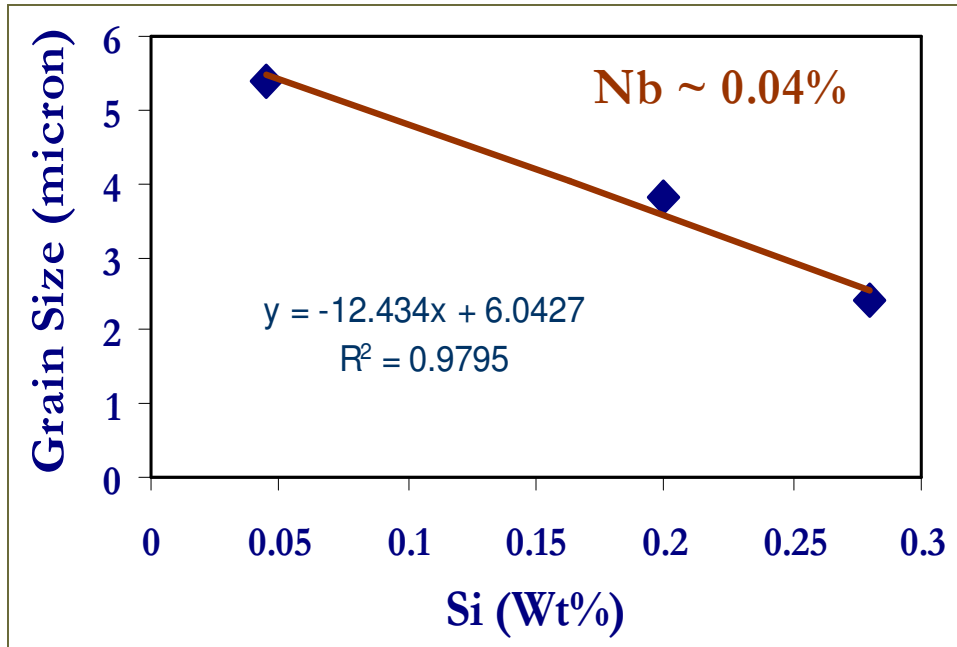
Si: 0.045 %



Si: 0.33 %

HSFQ 500 / 550

Commercial heats Nb (0.02-0.045 %) & Si (0.25-0.30 %)



Average ferrite grain size
~ 2.8 μm (0.042% Nb)
(uniform across the strip
thickness)

Breakthrough in technology for development of
“cost effective ultra fine grained steel”

Advantages

- ❑ It allows the users to increase the strength of the finished component
- ❑ Alternatively it will provide opportunity to reduce sheet thickness to make a design effective item
- ❑ Products more profitable and competitive by increasing the output from each tonne of steel

Stronger, lighter and safer product

**Strength & Formability of these grades expand scope for fabrication
Products can be manufactured by press forming rather than welding**

Applications

- Hydro-formed Sections

- Roll-formed Sections

- Prefabricated Structural sections

- Automotive Components

- Tubes

- Shelves

- Silos and containers

Diversified applications (HSFQ)



- **Customer : Laxmi Appliances, chennai**
- **EN 10028 P355 N**
(YS: 355 MPa, UTS: 490-630 MPa, % El: 22, CIE : 20 J at -20 C)
- **Application: Large (1000 litre) cylinder**

- **First manufacturer of such large cylinders in South Asia**

- **Customer : Hero Cycles, Ludhiana**
- **Application: High Tensile CR Structural (UTS : 500 Mpa min.)**



- **Customer : Ashok Leyland, Hosur**
- **Application: Long / Cross Member**
- **Completely switched over to HSFQ 450**

80 Ksi (HSFQ 550) : Highest auto chassis grade for HCV developed

Limitation of HSS / AHSS

❑ ULSAB / ULSAB AVC

New advanced grades and innovative processes –
Lightweight safe vehicle

❑ Use of HSS / UHSS

Stamping complex structural automotive components -
Difficult and capital-intensive

❑ Limited formability / Drawability with increased strength

Especially springback – Restricts Workability

❑ Introduction of innovative processes like hot stamping , hot forming, hydroforming

To overcome processing drawbacks with HSS/AHSS

Paradigm shift in auto segment from product to process

Innovative processing techniques

Traditional Stamping

at Room Temperature
on a mechanical press



Hot Forming

at elevated
temperatures
on a hydraulic
press + Air Cooling

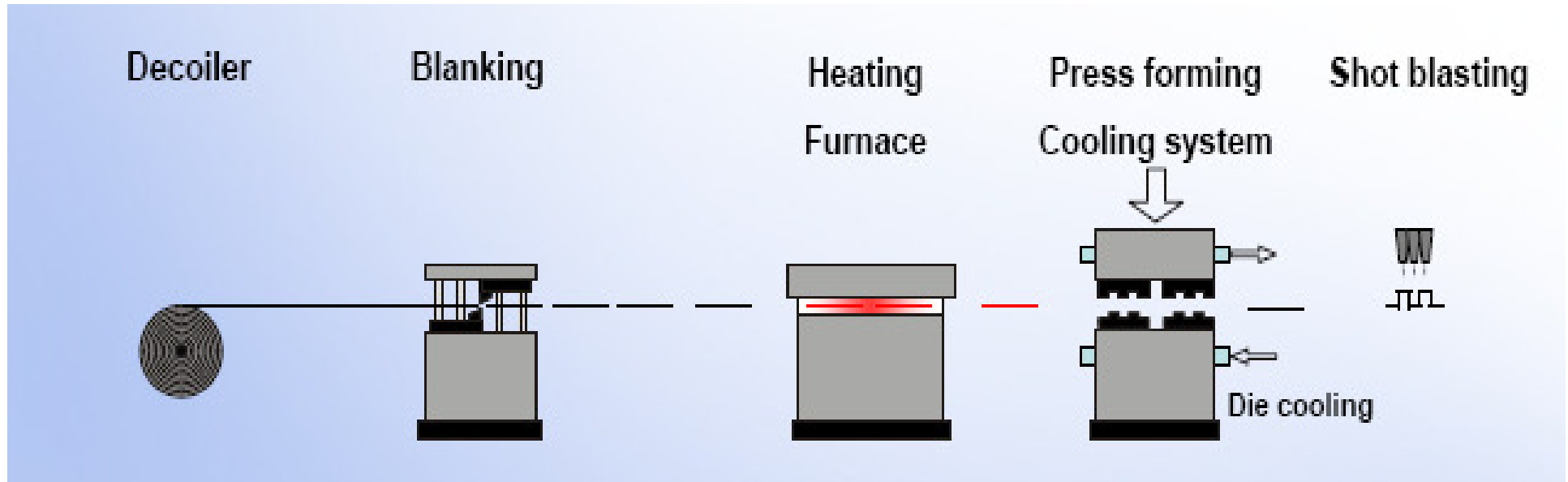
Hydro-forming

at room
temperature with
force of water or
hydraulic fluids

Hot Stamping

at elevated temperatures
on a hydraulic press with
a water-cooled die for
quenching

Hot Stamping



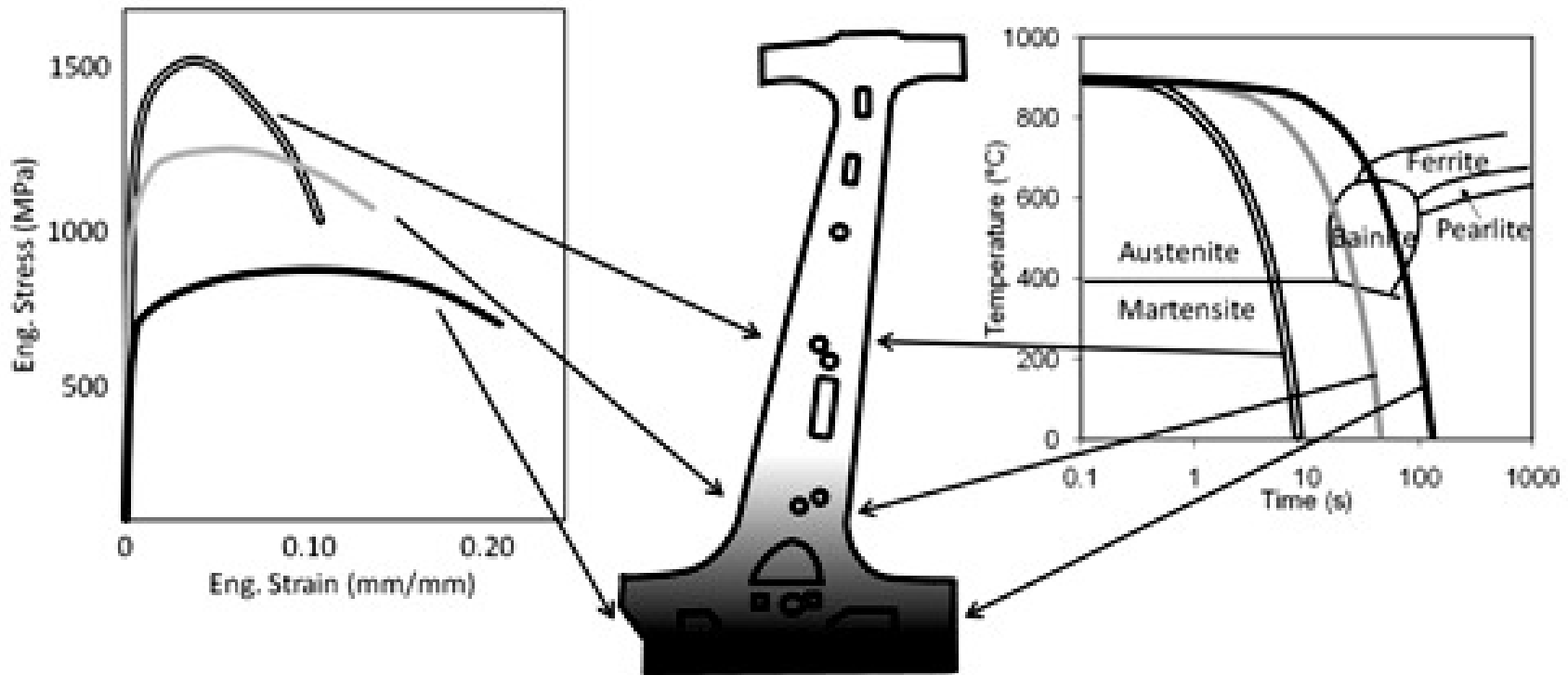
PROCESS

- *Evenly heating a steel blank,*
- *Forming it at precise forming pressures*
- *Cooling it at controlled temperatures in die*

*Hot stamping = forming + hardening
combined in a single operation*

Boron treated steel for Hot Stamping

- Retards the nucleation site of ferrite at the austenite grain surfaces,
increases hardenability of steels



Role of Differential Cooling

Advantages

- Tensile strength of hot stamped steel can reach 1500 MPa offering ultrahigh strength and lower weight.
- High hardness (up to 48 Rockwell C) and improved wear resistance.
- The process minimizes springback.
- Good repeatability in long production runs.
- Hot stamping provides excellent plastic formability in HSS.
- Low carbon content, favorable for welding.
- Production of complex shapes in a single hit.

Conclusion

- ❑ Development of High Strength Formable Quality (HSFQ) hot rolled steel (YS: 460/500/550 MPa min)
- ❑ Si in presence of Nb has enhanced grain refinement (<3 micron) in hot rolled steel
- ❑ Initiative for development of hot stamping grades

Thank you