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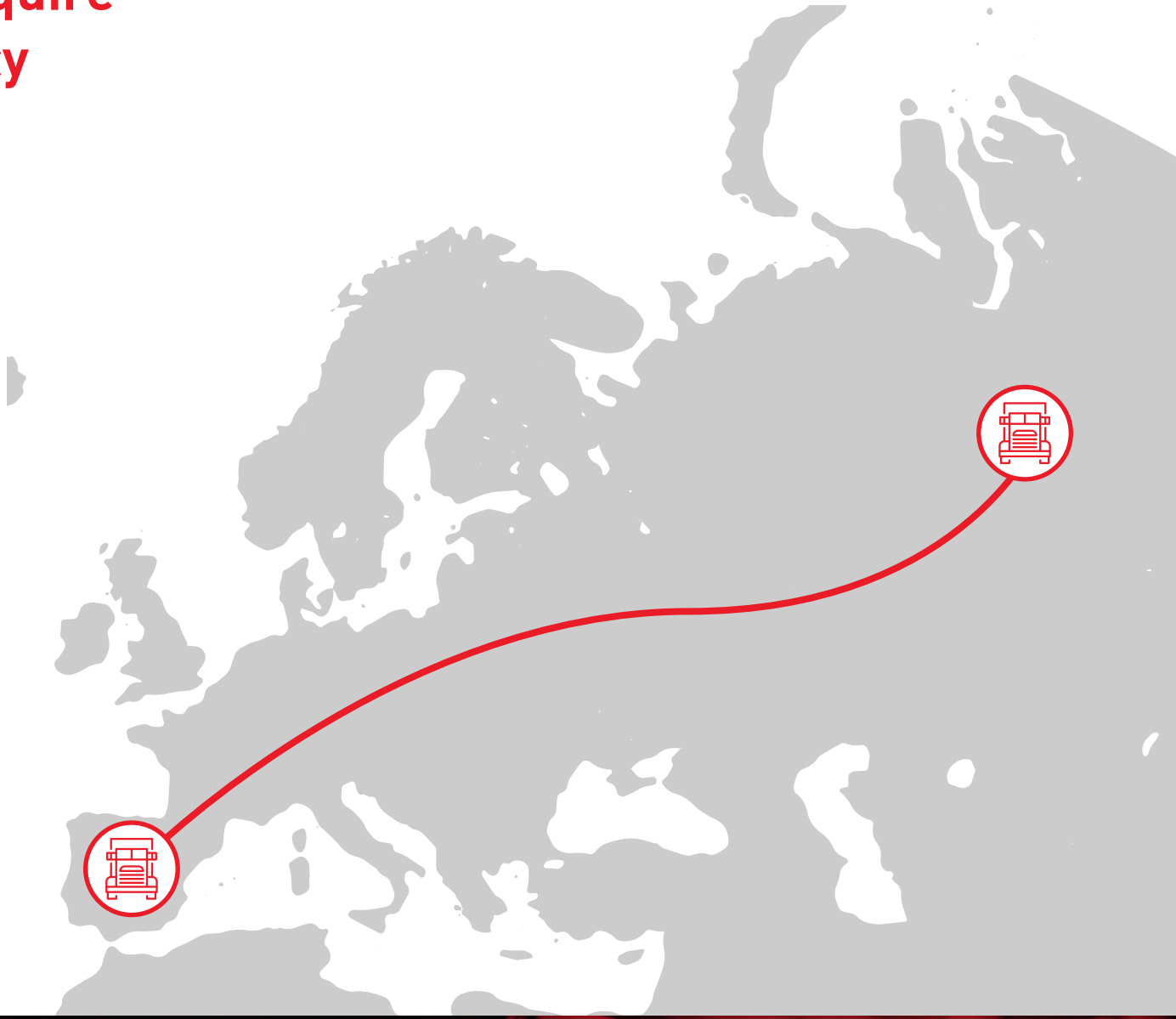
Ultralight Leaf Springs for Upcoming Front Truck Suspensions

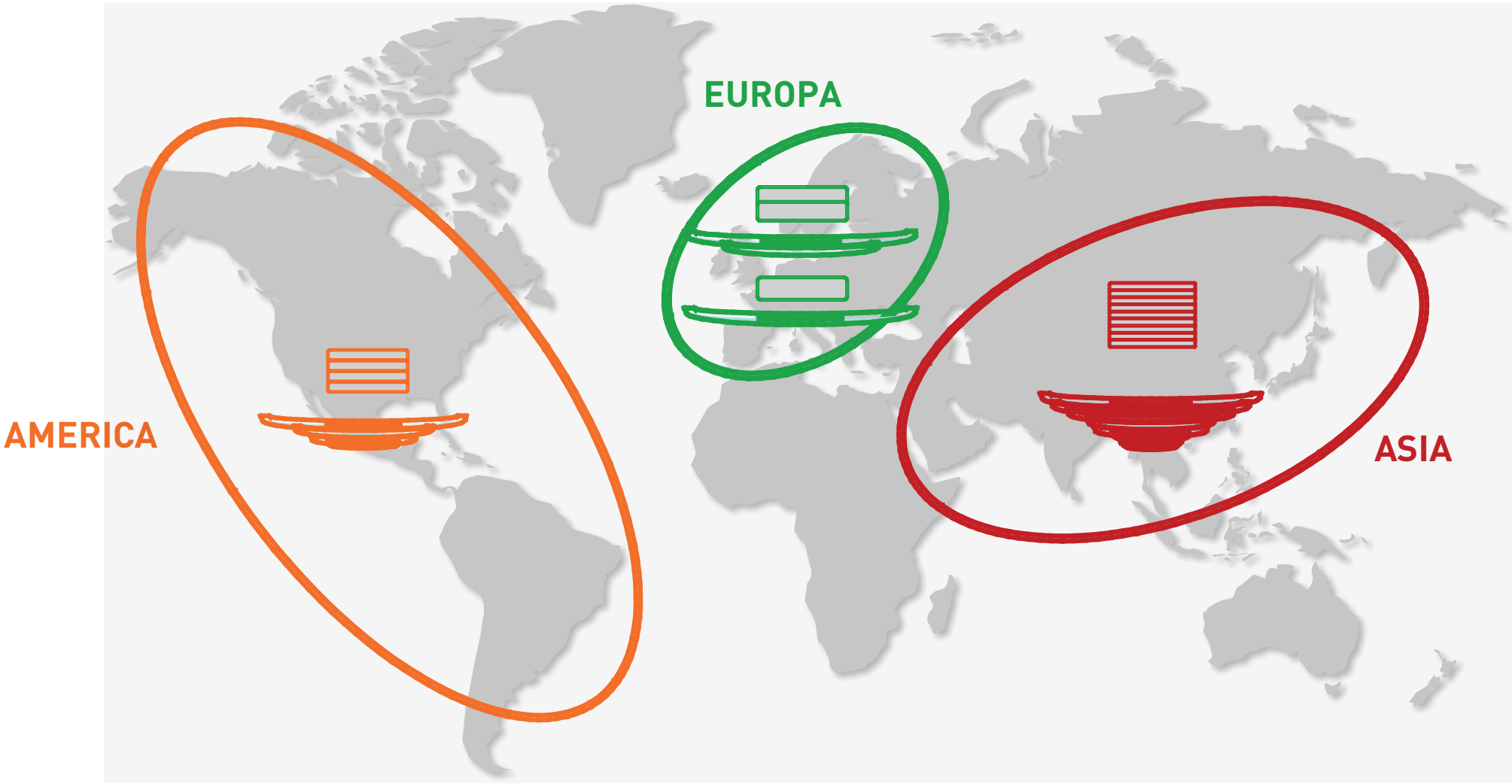
sidenor steel

Longer road distances require higher transport efficiency

Reduce chassis weight to Increase payload

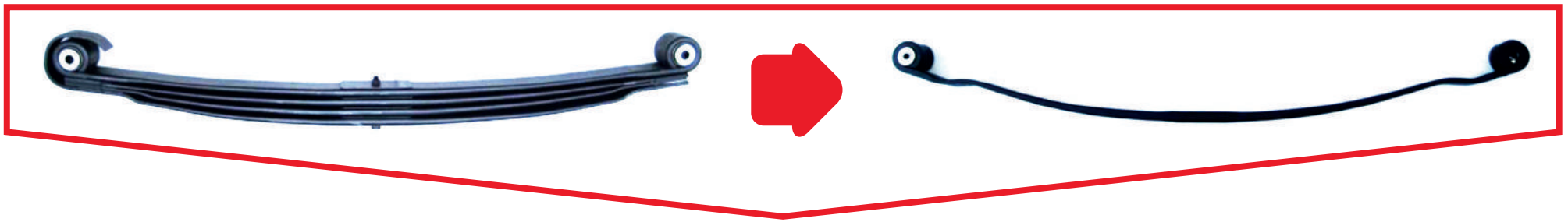


Front truck leaf springs in the world



Less leaves / less weight / higher stresses

- Leaf spring nominal stresses are rising and approaching to those typical of suspensions springs



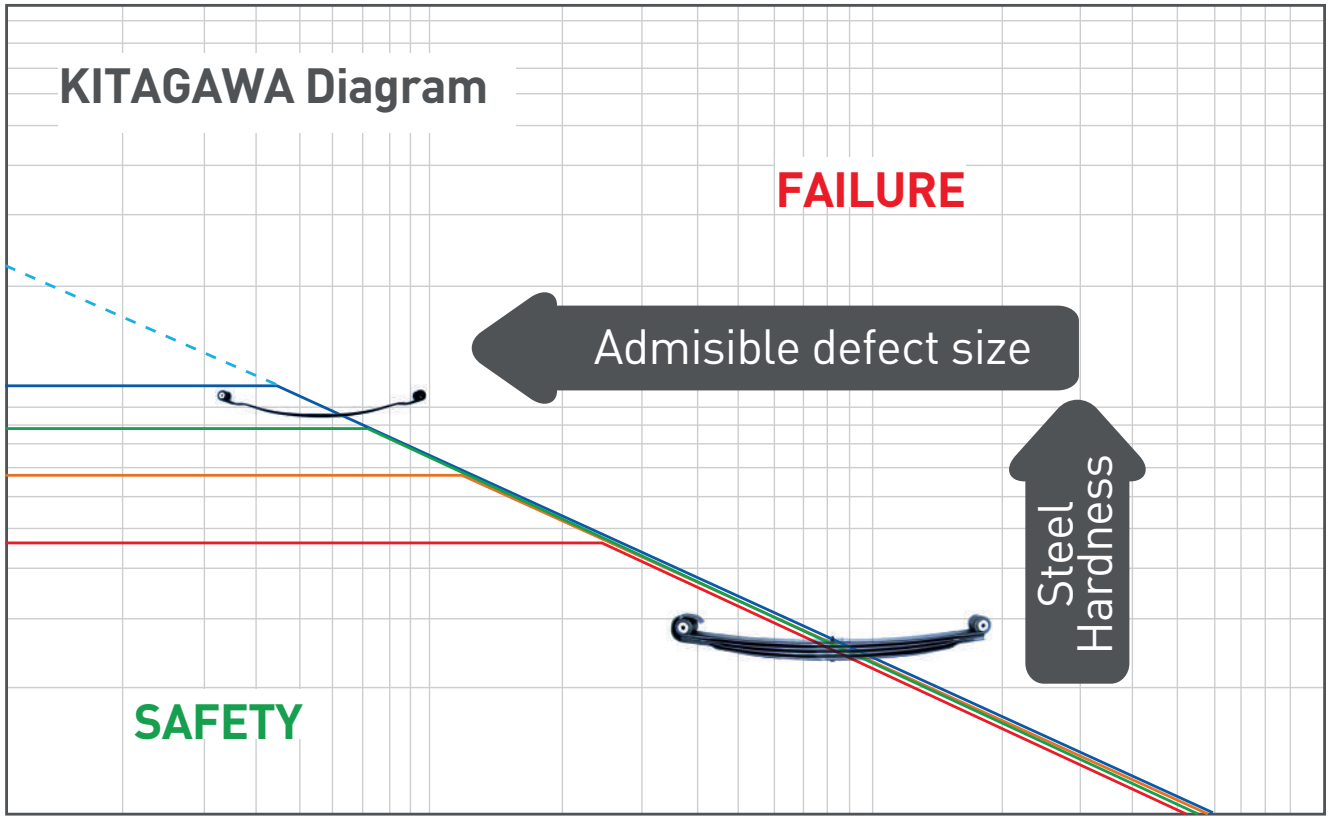
Less number of leaves Higher stresses
Thicker leaves Higher hardenability
Higher fatigue requirements

Weight reduction

-17% Weight -42% Weight

Higher Stresses: Smaller Admissible Defects

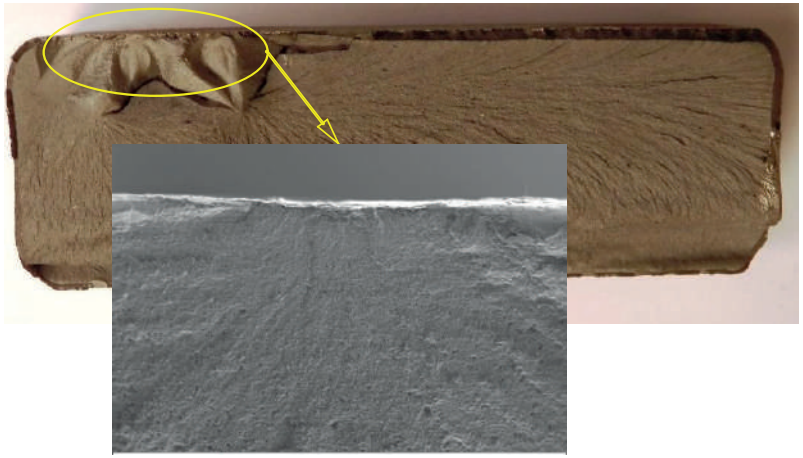
- Higher stresses imply much **higher failure risk**
- Admissible **defects must be smaller**
- Steels used for multileaf springs are not suitable any more



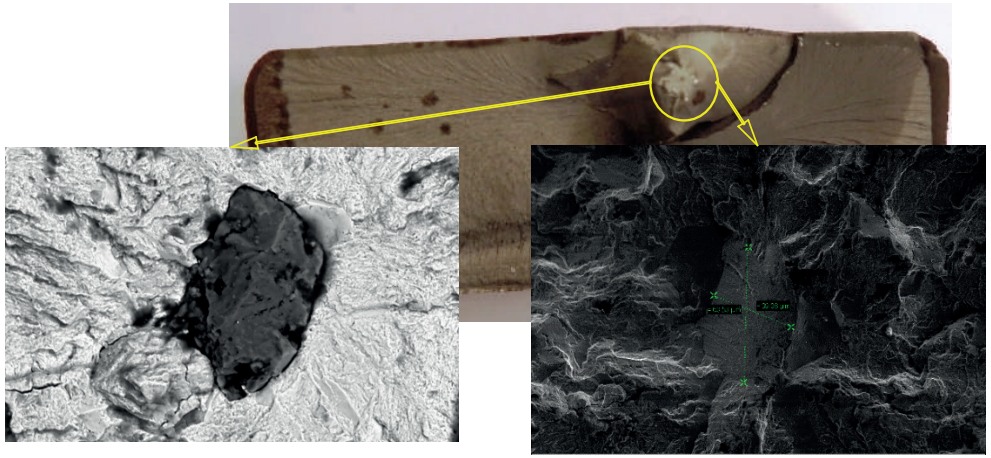
Higher stresses lead to fatigue issues

Early fatigue failures occur when lighter leaf springs must cope with higher stresses in the presence of surface and internal defects

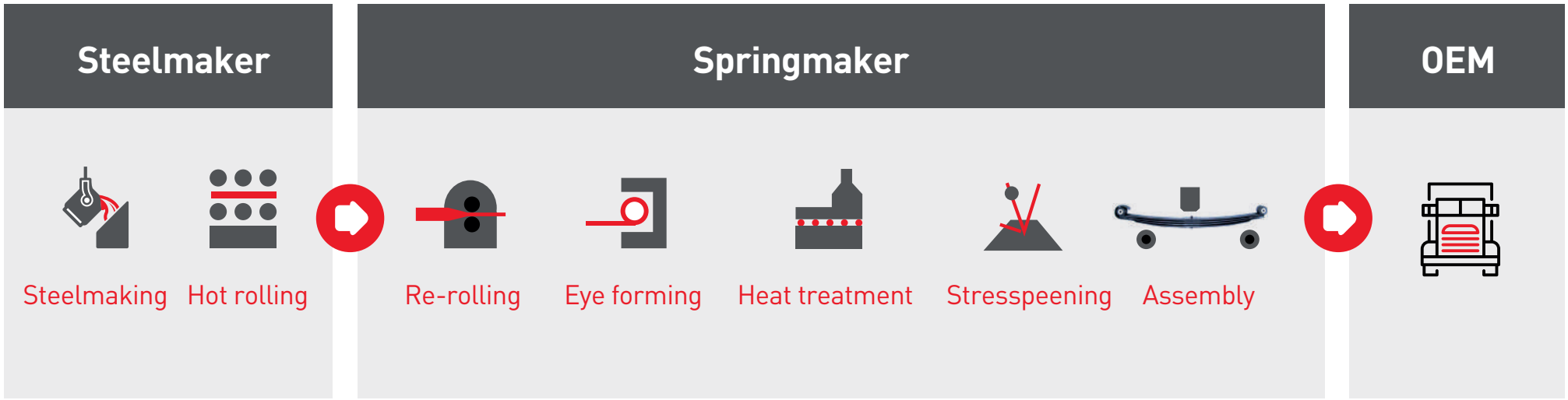
Surface defects



Internal defects



Current leaf spring manufacturing route



Flat Bar Products

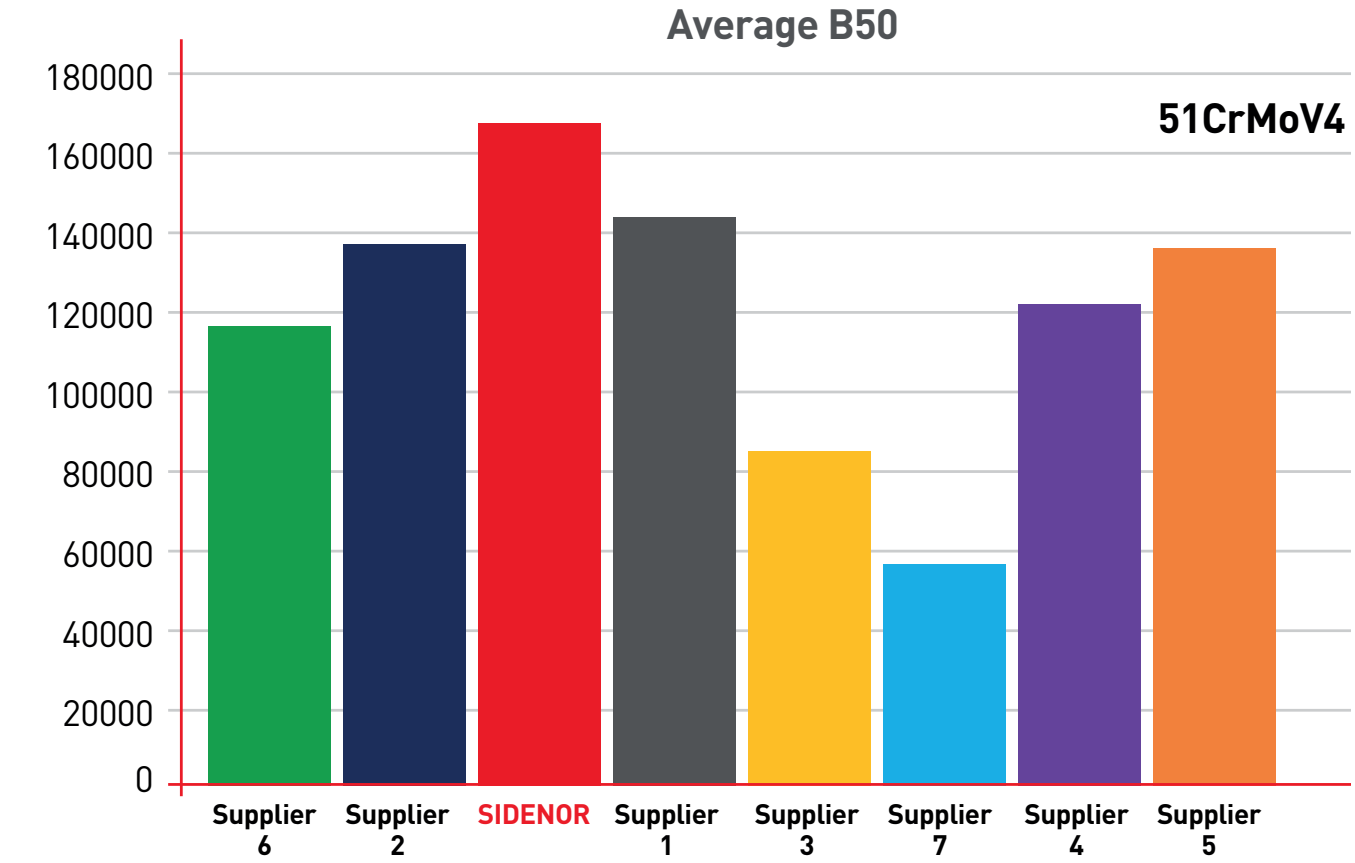
- Internal and surface flat bar inspections are not automatic, but manual
- A guarantee of “zero defects” is not possible nowadays
- Fatigue failures are due to defects non-detectable by current inspection methods

Similar... but not the same

- Apparently similar steel batches lead to a totally different fatigue performance
- Scatter among different industrial heats and steelmakers might lead to a 60% reduction in average of the fatigue life from higher to lower
- **A certain risk of service failures could be expected, as no standard method can rank properly steel suppliers' quality**

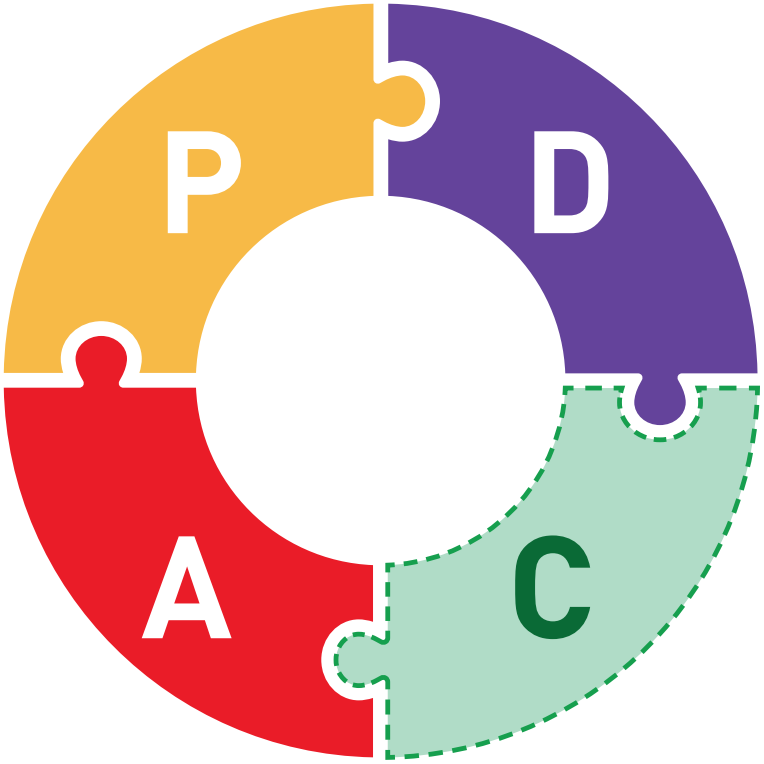
Leaf spring testing is not the solution...

- Even the average performance of steelmakers shows a big scattering, doubling the lifetime from top to bottom supplier.
- Component fatigue tests are able to sort out steel quality, but unfortunately they are not economically appropriate for the regular control of leaf spring serial production



Benchmark of leaf spring steel suppliers by component fatigue testing at customer facilities

Ineffective Quality Control



- **Standard controls consist in:**

  Visual inspection (for surface defects)

  Metalographic inspection (for internal defects)

  But, as these controls are clearly insufficient and inadequate...:

- **"Effective CHECK" activities are:**

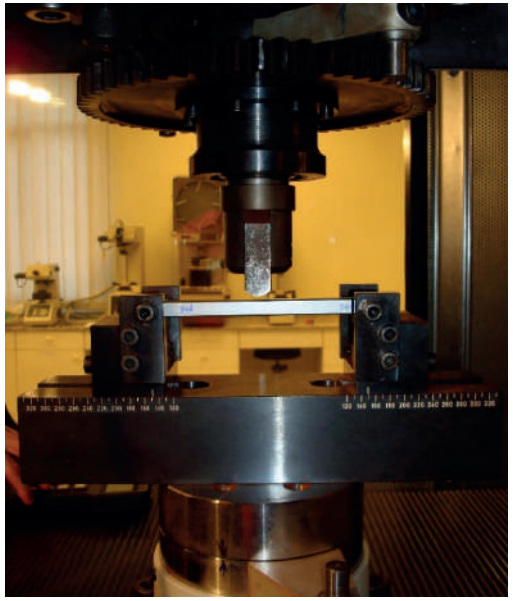
  Component fatigue testing (for homologation of new references)

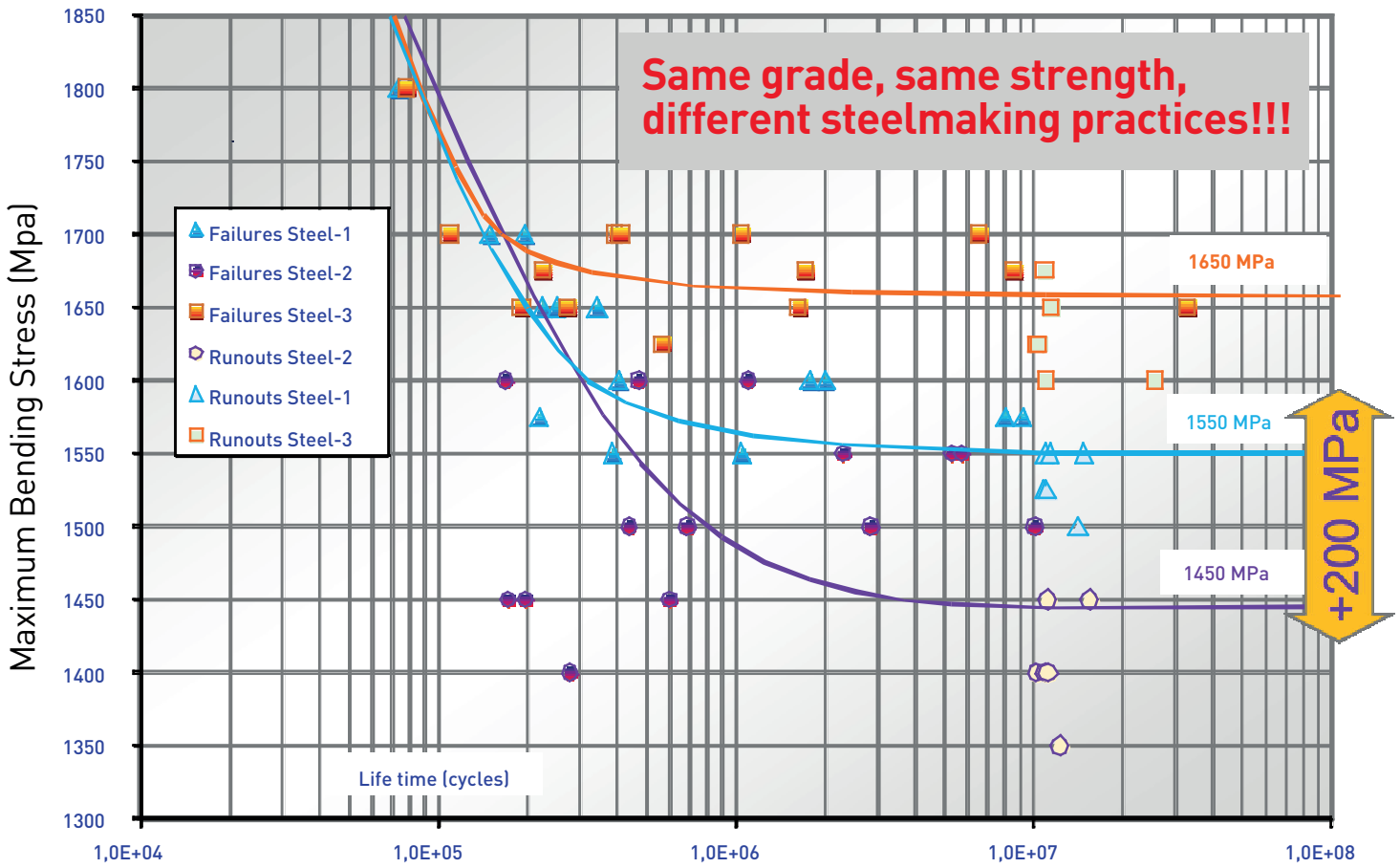
  Service failures!!!

Fortunately, new characterization methods are available to determine real level of steel quality and to improve manufacturing processes

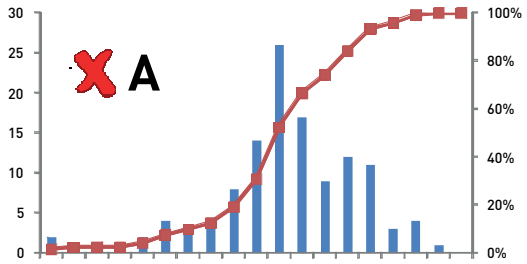
Fatigue testing

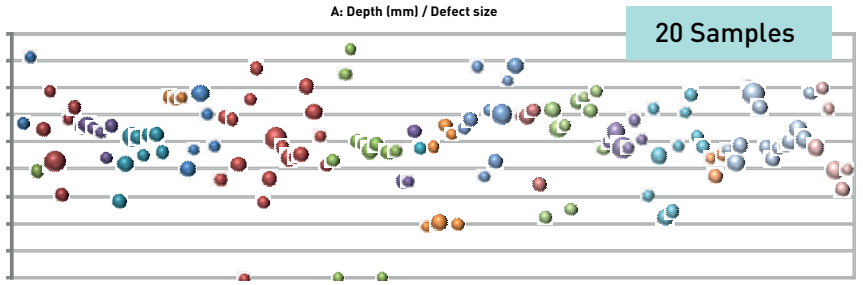
3-point fatigue testing correlates satisfactorily with component testing and allows a proper product characterization

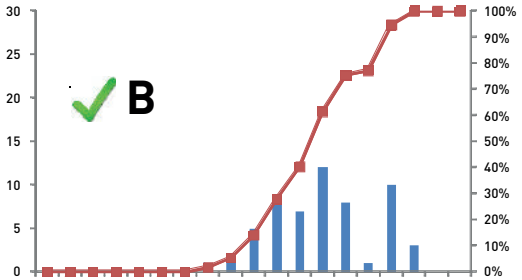


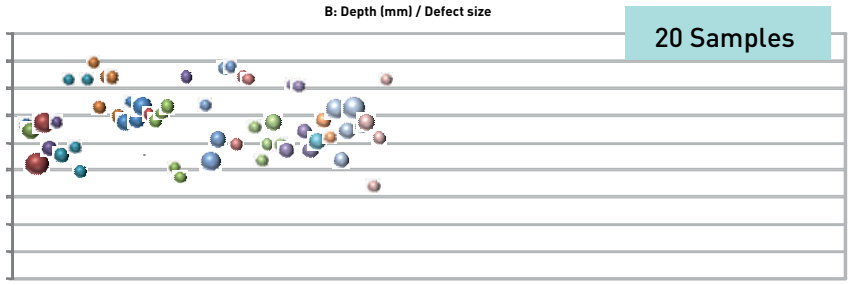


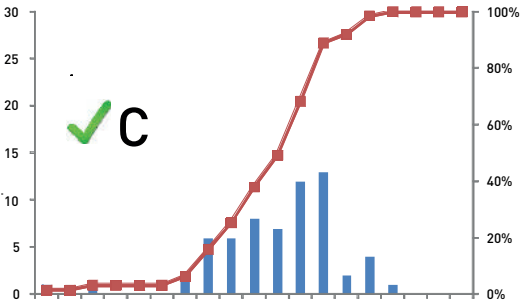
Quality assessment

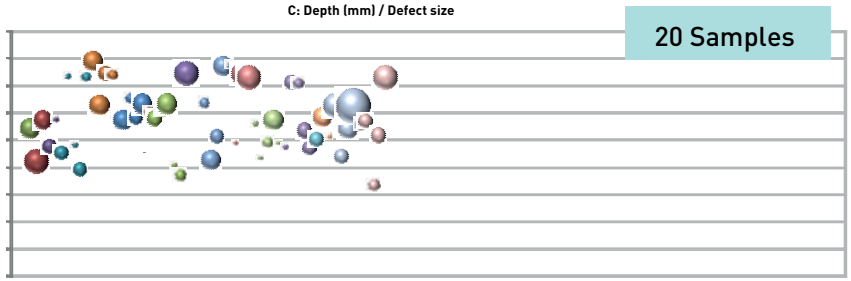






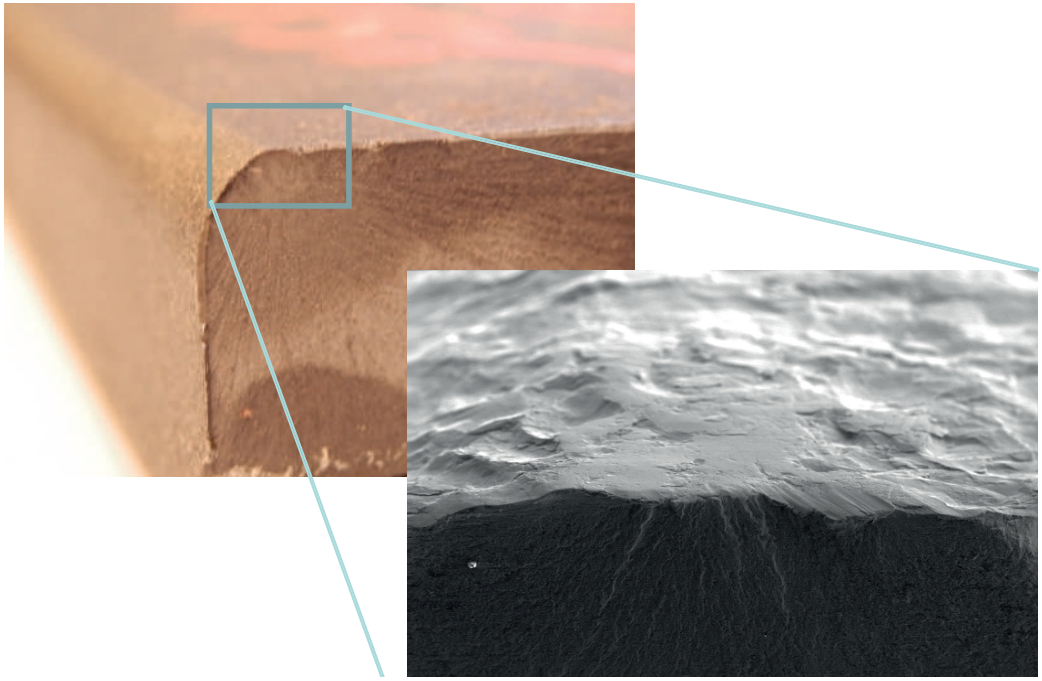


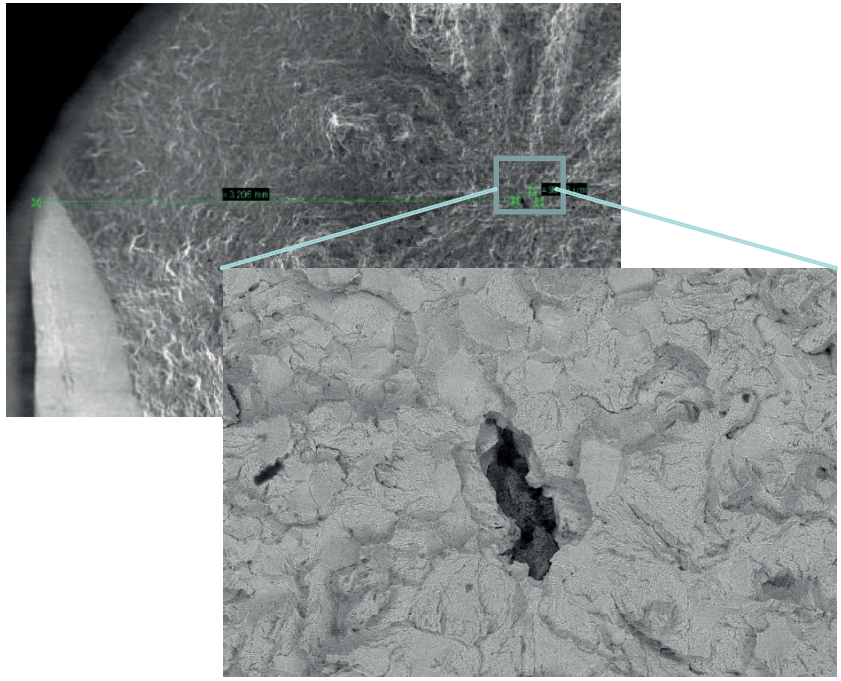




SEM Identification of failure causes

Surface and internal defects can be examined deeply and determined the root causes of fatigue failure to take corrective actions on the process

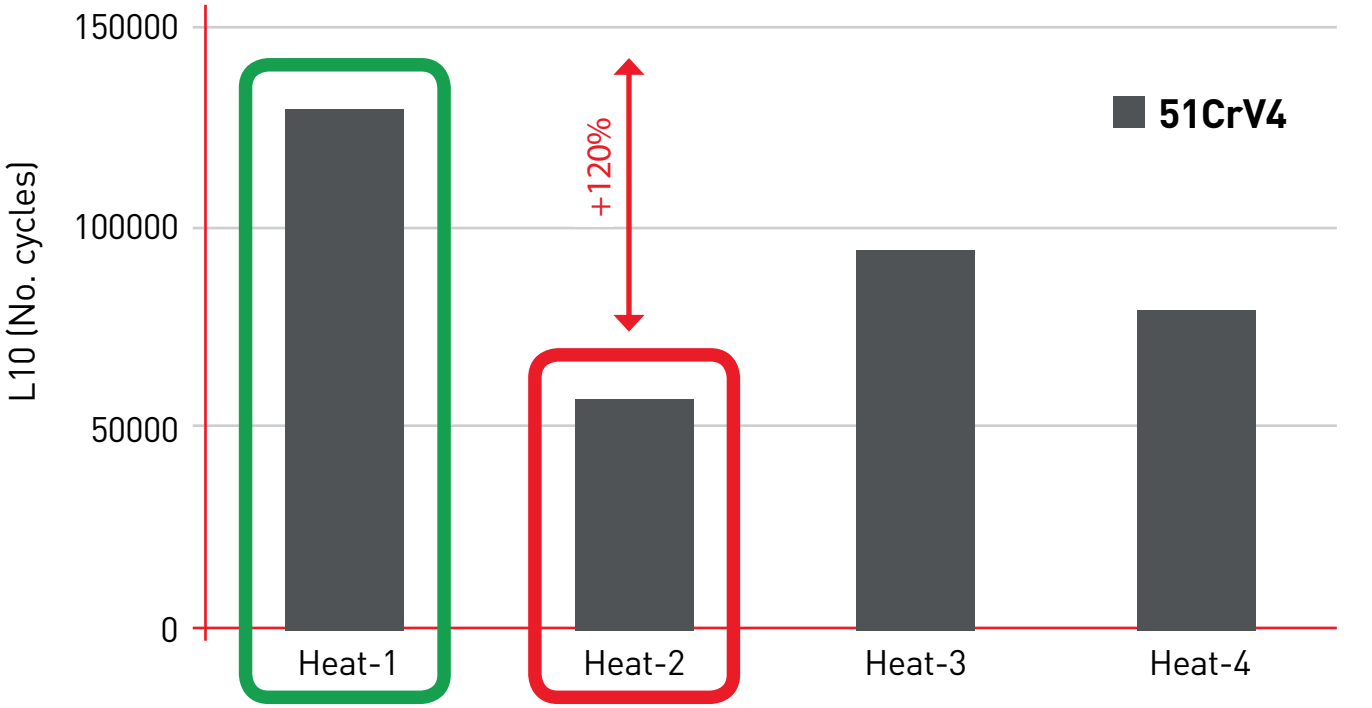




Conventional characterization is useless

Conventional characterization methods cannot differentiate properly between "good" and "bad" steel batches, leading to an inacceptable scatter

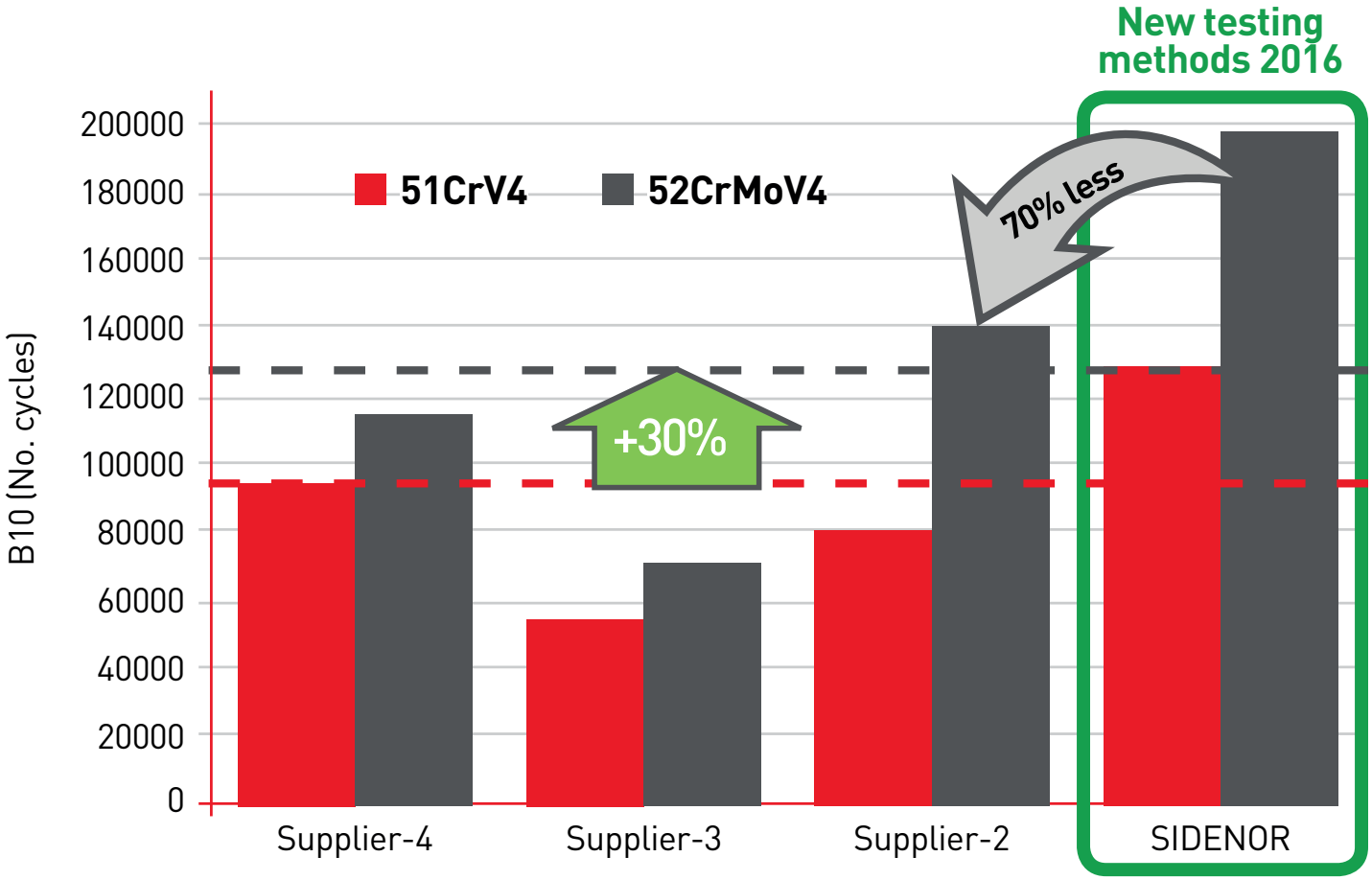
- Same strength
- Same toughness
- Equivalent microcleanliness evaluation
- Similar hardenability...but
- Different supplier!



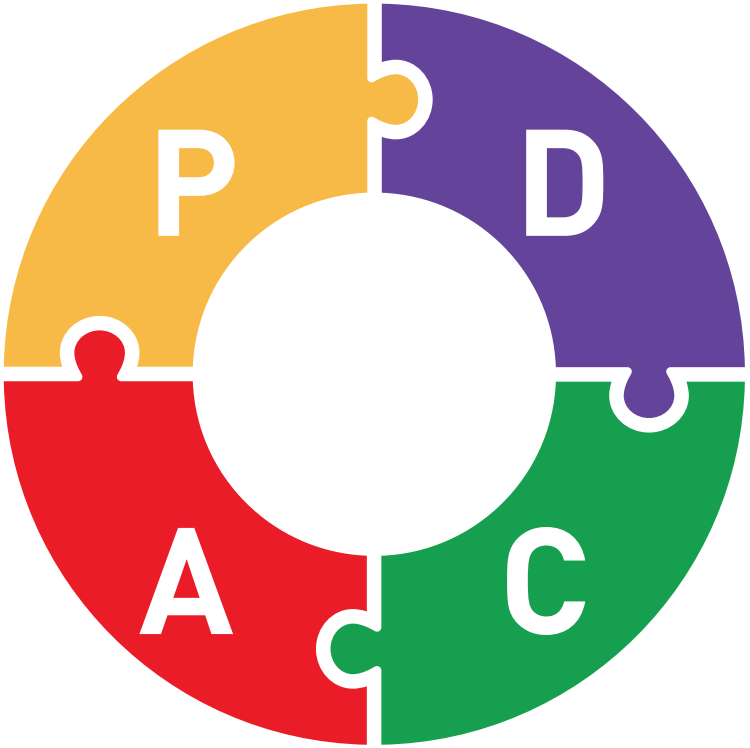
Benchmark of leaf spring steel suppliers by component fatigue testing at customer facilities

New methods discriminate and help to improve

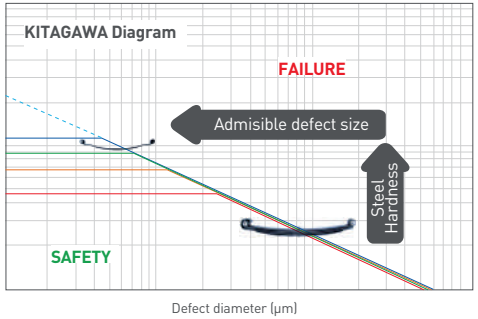
- New testing methods allow checking steel quality in a suitable way and improving service performance
- Using them, even downgraded steels might beat more alloyed grades with well-known best fatigue behavior

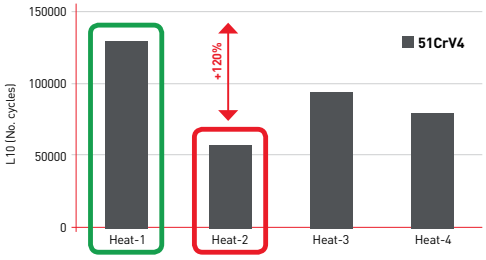


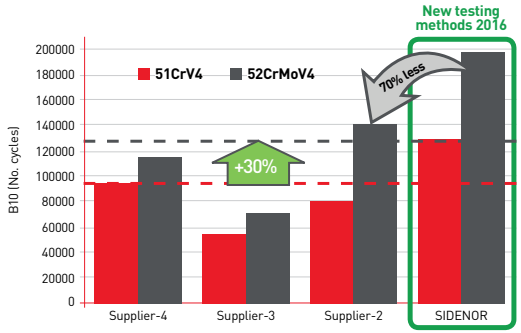
Conclusions



- Upcoming Ultralight Leaf Springs must cope with much higher stresses and traditional leaf spring steels are not valid any more
- **Conventional characterization methods are inappropriate** and misleading and cannot predict service performance properly
- **New characterization methods can adequately CHECK steel quality** and use it to improve steelmaking and spring making practices







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