

# INTERNATIONAL VALVE SPRING WIRE MANUFACTURERS ASSOCIATION

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## IVSWMA POSITION STATEMENT ON “INCLUSION LIMITATIONS FOR VALVE SPRING QUALITY WIRE”

ISO 8402 defines a defect as the “non-fulfilment of intended usage requirements.” This definition assumes that the “intended usage requirements” can be fulfilled. Thus, the party responsible for establishing the “intended usage requirements” and defining “non-fulfilment” must set achievable limits.

This statement is directed to all designers, manufacturers, and end users of valve spring quality wire products whose goal it is to achieve a finished product that fulfils its intended usage requirements. The failure of a dynamically stressed spring, such as a valve spring, during service due to a defect is usually the result of either a surface defect or an internal defect (inclusion). The subject of inclusions will be addressed in this statement.

### INCLUSION LIMITATIONS:

Over the past decade, steelmakers have made considerable progress in the development of valve spring quality steels with enhanced cleanliness, and they have been able to successfully reduce the size and frequency of harmful nondeformable inclusions. Over a six-year period, the average maximum inclusion thickness found in outgoing inspection has been reduced by 25 percent.

While there has been marked improvement in steel quality, there are still limitations in inclusion control and inspection capabilities. It is with this fact in mind that the IVSWMA group presents this position statement which has been developed and supported by all members and associate members of the organization.

- ❖ Inclusions are unavoidable imperfections in the steel. Regardless of the steelmaking method, some types of undesirable inclusions will exist.
- ❖ Most current valve spring quality wire specifications limit the allowed inclusion thickness within a one-millimeter surface zone of 15 microns, when inspected using optical methods. By other types of testing, it has been confirmed that

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good quality steels produced with today’s most advanced technology will certainly contain inclusions in the size range above 30 microns in thickness.

- ❖ Because of the sample size and the statistical nature of inclusion distribution, optical inspection is unlikely to find the largest inclusions in a heat of steel. No inspection techniques have been developed to date that enable suppliers to guarantee cleanliness throughout the entire length of a rod bundle, nor is there a more reliable and practicable method other than optical inspection to qualify material for shipment.
- ❖ Spring designers and spring manufacturers must take into account the unavoidable limitations of maximum inclusion size and inspection for inclusions. Springs should not be designed with unreasonably high-stress levels. Spring manufacturing methods need to be optimized and closely controlled.

All levels of the supply chain must understand the essential elements necessary to limit inclusions and optimize the field performance of valve spring quality products. The steel-maker must control and further improve the critical process parameters in refining, casting, and hot rolling. Both steelmaker and wire maker should perform inspections using accepted methods, according to agreed upon inclusion thickness criteria. The spring maker must develop and control his process to optimize the residual stresses in the surface zone of the finished product.

IVSWMA is a group of worldwide companies that produce valve spring quality (VSQ) steel wire rod and VSQ wire for the production of springs (such as valve springs for automotive applications). The current membership of the IVSWMA group is as follows:

**MEMBERS OF THE INTERNATIONAL VALVE SPRING WIRE MANUFACTURERS ASSOCIATION**

1. AMERICAN SPRING WIRE CORPORATION
2. ARCELORMITTAL DUISBURG GMBH
3. KISWIRE, LTD.
4. KOBE STEEL, LTD.
5. NIPPON STEEL & SUMIKIN SG WIRE Co., LTD.
6. NIPPON STEEL & SUMITOMO METAL CORPORATION
7. JOH. PENGG AG
8. POSCO
9. SHINKO WIRE COMPANY, LTD.
10. SUMITOMO (SEI) STEEL WIRE CORPORATION
11. SUNCALL CORPORATION
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