| Guideline | 7/17 | CLAP | FORM N°185 |
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| | | | Version : 4 |

| Directive 97/23/EC | Keywords : | Material | Quantitative requirement |
|---|---|---|---|
| | | Standard | Material recognised as being safe |
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| | Directive references: | Annex I § 4.1a - 97/23 EC | Annex I § 7.5 - 97/23 EC |
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**Adopted by WPG:** 18/04/2007 **Adopted by CLAP:** 18/04/2007

**Subject:** ESR on materials – Impact properties of a steel grade

**Question:** What approach can be used to decide if a steel grade selected for a pressurized part requires specific impact properties?

**Answer:**



1. The philosophy of the approach outlined below takes account of the hazard analysis performed by the manufacturer in relation to the toughness necessary for the identified failure modes (e.g. brittle fracture) in the finished pressure equipment.

2. The exception concerns “ductile materials which are not subject to a ductile/brittle transition at the foreseeable conditions the equipment will be exposed to”.
Examples of such materials are: austenitic stainless steels.
Some design codes provide specific rules for the avoidance of brittle fracture that takes account of the anticipated or actual operating conditions prevailing, e.g. material, thickness, temperature, etc. Where the application of these rules indicate that the material will not behave in a brittle manner and all aspects of the chosen design code have been followed, sufficient confidence is gained in the behaviour of the material not to require specified impact properties. When these design codes are applied also other items need to be taken into account (see item 3 below).

3. The justification for omission of the impact properties shall be based on the most adverse possible combination of all elements of the steel grade specification, such as:
- the full permissible range of the chemical analysis,
- the extreme mechanical properties,
as documented and permissible in the specification and not on the values of the actual deliveries.

The consequence of the worst combination of chemistry must be considered because the specified range of chemical analysis for some materials could result in brittle behaviour,. Where appropriate, such materials could be accepted if the chemical composition and mechanical properties are restricted in the purchase order and in the particular material appraisal to such levels that, from experience, do not give rise to brittle fracture.
EXAMPLES include Manganese-Carbon ratio, Carbon, Sulphur, Phosphorus content, Aluminium to Nitrogen ratio.
Other restrictions may include:
- avoiding inter-metallic phases,
- avoiding large grain sizes,
- placing limits on mechanical properties.

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**Answer:**



Manufacturers and notified bodies must demonstrate that they have taken such factors into account in documenting the necessary PMAs.

4. Furthermore subsequent manufacturing processes affecting the impact properties of the material shall be taken into account, when making the above assessment. Following all the rules in the design code should generally ensure that this requirement is met; however additional requirements may also be necessary to ensure that all relevant ESRs have been met.
Examples: forming, heat treatment, welding.

5. However, verification testing of specified impact property may not be required in case where there is no doubt about the fulfilment of the essential safety requirement on sufficient toughness to avoid brittle fracture.
Examples: most austenitic stainless steels.

Reason: Impact property values are the most common way to fulfil the essential safety requirement of toughness, it is not the only route.
Examples: restriction on operating temperatures, fracture mechanics.

Note 1: Each harmonized European steel has specified impact properties.
Note 2 : A "history of safe use" alone cannot replace the need for the specifications of impact properties. This notion is inextricably linked to a particular code, set of safety factors and safety philosophy and can therefore not necessarily be transferred to a different safety philosophy/concept.

Following the requirements of an established design code alone does not provide a presumption of conformity" and a simple claim by the manufacturer that they "have followed the specified code" is not in itself a justification. Established Codes may be used as the basis for meeting the essential safety requirements however it is necessary to compare the selected Code requirements to the essential safety requirements and identify and address any deviations. This requires those using the Code to have a good understanding of the principles involved, rather than mechanistic following of rules.