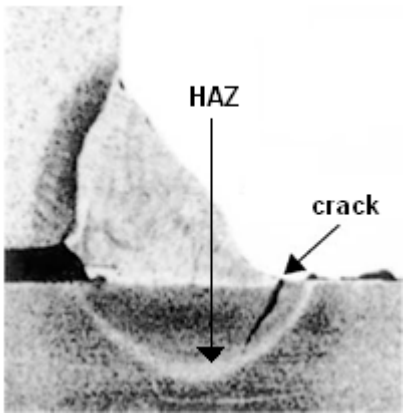
Cold Cracking

Cold crack or hydrogen crack it's one of the biggest problems for welding structural steels, since it's related to the premature failure of welded components, helping the initiation of the fragile or fatigue fracture. It occurs when the welded joint approaches the room temperature and can develop at an initial stage and go up to 48 hours after the process is complete. Usually theses cracks appear on the heat affected zone (HAZ) but can also occur in the welded metal and can be of several types such as longitudinal, transversal, superficial and sub-superficial.



Images from www.demet.ufmg.br/labs/**soldagem**/textos/metsol03.pdf

The images show cold cracks, in a macrographic aspect and in a micrographic aspect.

This defect occurs as the result of the three following aspects:

- The presence of hydrogen in the welded joint from molecules of the organic material and humidity which are dissociated in the arch;

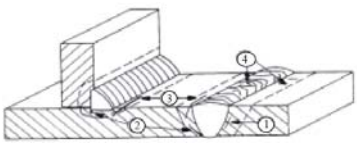
- The formation of a microstructure of extreme hardness wich depends on the velocity of cooling and the composition of the material, if the equivalent carbon present in the material is less then 0,4 the steel is insensitive to the cracking and if it's bigger then 0,6 the material will be very sensitive to cracking

$$Ceq = \%C + \frac{\%Mn}{6} + \frac{\%Mo}{4} + \frac{\%Cr}{5} + \frac{\%Ni + \%Cu}{15} + \frac{\%P}{3}$$

- The solicitation of residual tensions and extern tensions caused by the contractions of cooling and the hardness of the joint.

To avoid the formation of cracks in the welded joints, the following can be done:

- Pre-heating the base material in order to reduce the speed of cooling, preventing the formation of martensite on the weld and allowing the hydrogen to be removed from the weld;
- Reduce tensions concentration avoiding discontinuities on the weld or selecting well the disposition of the welds and the assembly sequence of the structure;
- Use welding consumables with low hydrogen to minimize the hydrogen diffusion on the weld;
- Selecting the appropriate welding process for the material in question always taking into account the aspects mentioned above.



1.underbead cracking
2.root cracks
3.toe cracks
4.transverse cracks
Image from
www.ee.pucrs.br/~jfazzi/SoldagemII/fissuhidro.pdf