TECHSUPPORT #61

Benefits of the term – single plate thickness – compared to the parameter – combined plate thickness – in joints

SSAB develops and continually improves the welding recommendations for Weldox® structural steels and Hardox® wear plates. As a result, the preheat/interpass temperature can now be optimized further for a given welding situation. To enable the new recommendations to be put to use, the term combined plate thickness in joints will be replaced by the concept of single plate thickness.

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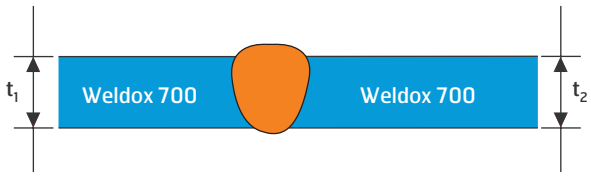
The single plate thickness is defined as:

ONE OF THE PLATE THICKNESSES IN EXAMPLE 1 AND 2 IS t_1 AND t_2, PROVIDED THAT THE SAME STEEL GRADE AND PLATE THICKNESS IS USED THROUGHOUT THE JOINT.

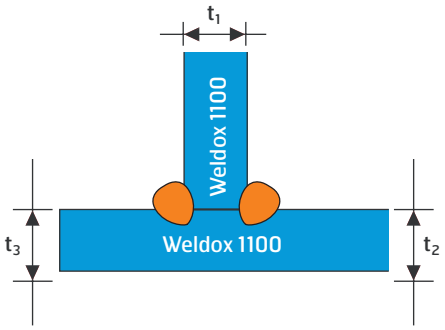
EXAMPLE 1

Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Weldox 700 (t_1)	10	20	20
Weldox 700 (t_2)	10	20	



EXAMPLE 2

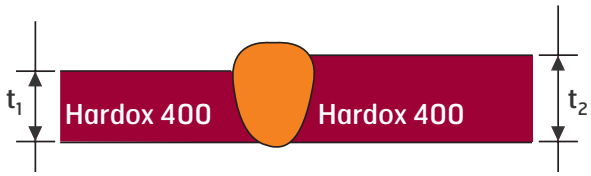
Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Weldox 1100 (t_1)	12	75	75
Weldox 1100 (t_2)	12	75	
Weldox 1100 (t_3)	12	75	



THE THICKEST PLATE IN THE JOINT IF THE COMPONENT PLATES ARE OF THE SAME STEEL GRADE.

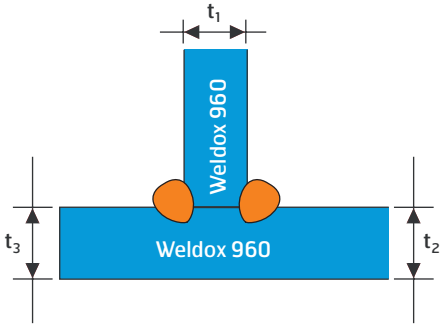
EXAMPLE 3

Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Hardox 400 (t_1)	42	75	100
Hardox 400 (t_2)	47	100	



EXAMPLE 4

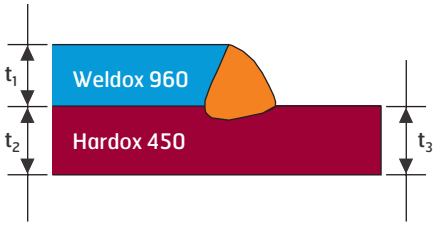
Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Weldox 960 (t_1)	11	75	100
Weldox 960 (t_2)	17	100	
Weldox 960 (t_3)	17	100	



WHEN THE JOINT INCLUDE DIFFERENT STEEL GRADES: THE PLATE WITH THE HIGHEST PREHEAT/INTERPASS TEMPERATURE

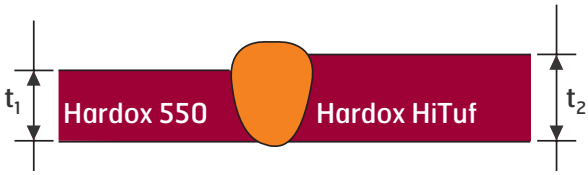
EXAMPLE 5

Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Weldox 960 (t_1)	12	75	75
Hardox 450 (t_2)	12	20	
Hardox 450 (t_3)	12	20	



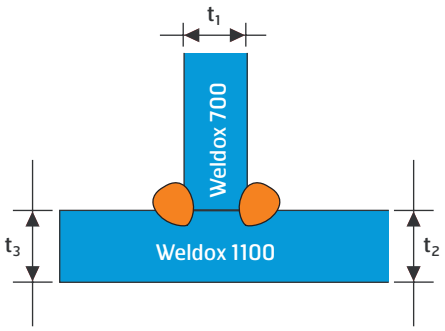
EXAMPLE 6

Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Hardox 550 (t_1)	37	200	200
Hardox HiTuf (t_2)	42	100	



EXAMPLE 7

Steel	Single plate thickness [mm]	Min. preheat/ interpass temperature for the steel [°C]	Minimum preheat/ interpass temperature for the joint [°C]
Weldox 700 (t_1)	10	20	125
Weldox 1100 (t_2)	18	125	
Weldox 1100 (t_3)	18	125	



The benefits of using the method based on single plate thickness instead of the concept for combined plate thickness are:

1. The parameter - single plate thickness - facilitates that the preheat/interpass temperature is always determined from the correct chemical analyses of the steels in the joint.

2. For a joint consisting of plates of different thicknesses but of the same steel grade: In this case, the thickest plate requires the highest preheat/interpass temperature during the welding. By directly adapting the preheat/interpass temperature to the thickest plate, the preheat/interpass temperature will be specified more precisely.

   In the earlier model based on combined plate thickness, the plate thicknesses were added together, and the calculation model was therefore not as accurate.

3. In the case of a welded joint consisting of different steel types: The model that uses the single plate thickness gives a preheat/interpass temperatures which is better matched to the welding operation compared to the method based on a combined plate thickness. This is because the method using the single plate thickness ensures that the correct chemical analysis of the steels is used when calculating the preheat/interpass temperature, which is not the case in the model based on the combined plate thickness.

4. The methodology based on single plate thickness has been especially developed for high strength steels. The result is that the preheat/interpass temperature during the welding can be optimized further.

   The earlier model based on a combined plate thickness can be used for high strength steels, but is more suited for unalloyed and low-alloyed steels with lower strengths than the Weldox and Hardox steels.

5. The preheat/interpass temperatures for Weldox and Hardox grades are determined in accordance with the TEKKEN test procedure, which is an internationally acknowledged procedure. The results of a TEKKEN test for a given welding situation can be expressed directly in the form of a recommended preheat/interpass temperature for the single plate thickness of the joint.

6. It will be possible to reduce the preheat/interpass temperature for a fillet joint compared to when the preheat/interpass temperature is determined on the basis of the combined plate thickness.

7. For a joint in Weldox: Consumables with a yield strength ($R_{p0.2}$) of more than 700 MPa often have a carbon equivalent that is higher than that of the Weldox grade(s). In such cases, the preheat/interpass temperature for the consumable must also be taken into account.

   The European Standard EN 1011-2, Method B, which also uses the concept of the single plate thickness, can be applied used for determining the preheat/interpass temperature for the consumable. TechSupport # 60 gives estimated general values of required preheat and interpass temperatures for these high strength consumables. Actual values are based on the single plate thickness. Use a preheat/interpass temperature that is suitable for the steel(s) included in the joint and for the relevant consumable.

   There is no established model for calculating the preheat/interpass temperature of the consumable on the basis of the combined plate thickness of the joint.

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