

HARDOX®

TechSupport

Information from
SSAB Oxelösund.

#29

Welding of cutting edge to bucket and adapters to cutting edge

TechSupport is a series of publications about HARDOX wear plates from SSAB Oxelösund. Each publication is available as a printed brochure, a pdf file and a PowerPoint presentation. For more info, contact your HARDOX Customer Service, www.hardox.com

Editor: Bogoljub Hrnjez. Date: 20/05/2008. Version: uk 02. Page 1
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HARDOX®
WEAR PLATE

Welding of the Teeth Adapters



- ❑ Welding of teeth adapters to the cutting edge is a critical welding operation under the bucket manufacturing process.
- ❑ The risk for hydrogen cracking in the welded area is evident due to the heavy gauges and hard material involved as well as the high weld restraint condition.



Material for the Cutting Edge



- ❑ Important to reach a balance between hardness and toughness
- ❑ Thicker cutting edge requires tougher material

Steel selection for the cutting edge depends on the plate thickness:

Recommendations:

- ❑ HARDOX 500, thickness up to 50 mm
- ❑ HARDOX 400/ 450, thickness up to 80 mm
- ❑ HARDOX HiTuf, thickness up to 120 mm

Typical impact toughness/ -40C

30J

45J / 35J

70 – 95J

Main types of the adapters



Flush Mounted Adapter
Mostly used for loader buckets



Top Strap Adapter
Used for loader buckets



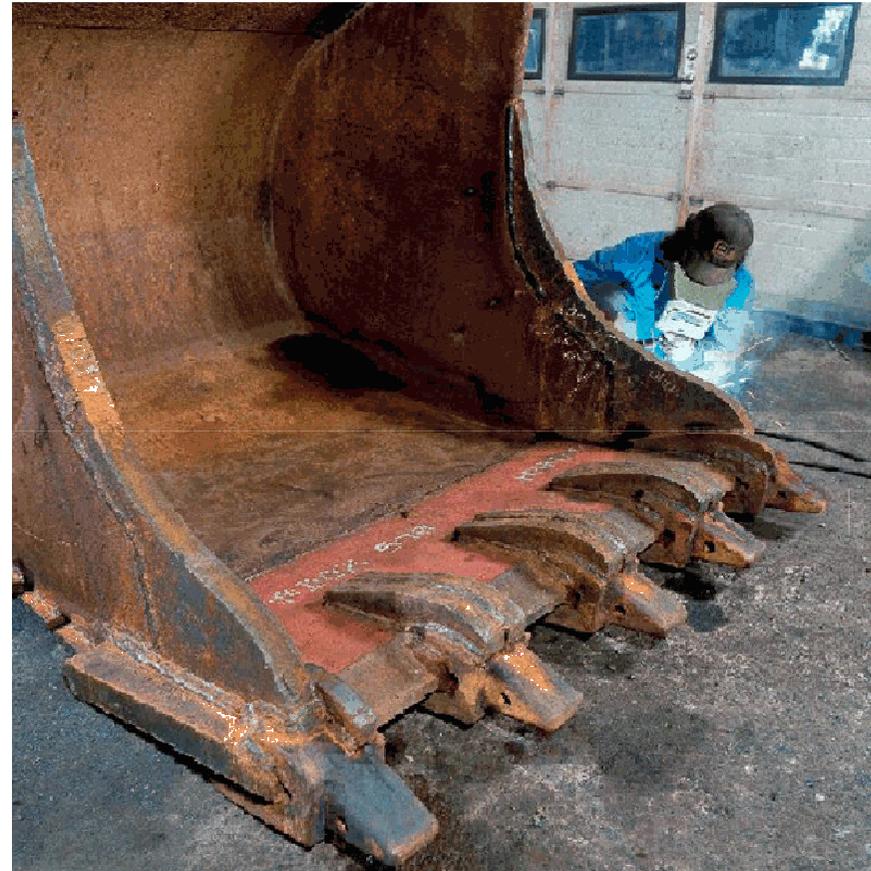
Bottom Strap Adapter
Used for excavator buckets

Welding methods



Recommended welding methods
for welding of buckets

- MMA
- MIG/MAG
- FCAW



Bevelling of the Cutting Edge

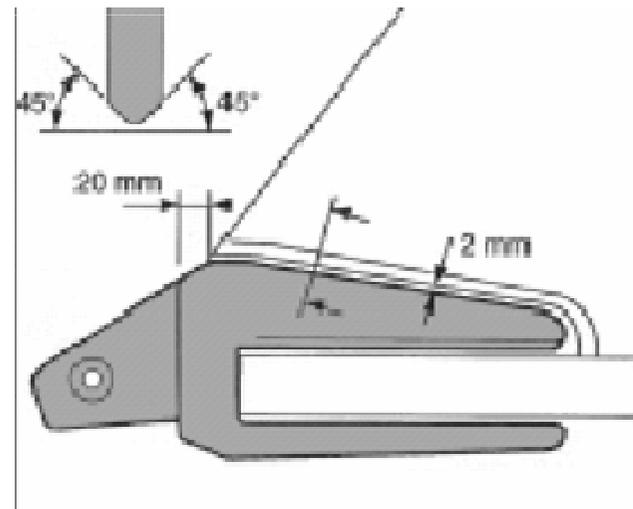


- ❑ Bevel the front of the cutting edge to the angle recommended for the specific adapter.
- ❑ If oxy-fuel cutting is used for bevelling, the cutting operation is recommended to be performed as submerged in water. This in order to reduce softening.
- ❑ For minimizing the risk for hydrogen cracking it is important not to exceed the cutting speeds recommended for oxy- fuel cutting of HARDOX wear plates, see [TechSupport #16: Cutting of HARDOX](#)
- ❑ Stress raisers like sharp edges has to be grinded off.

Joint preparation



- ❑ Grind the fitting surfaces of the cutting edge and the adapter smooth
- ❑ Remove all paint, rust, grease and dirt from the surfaces to be welded.
- ❑ If possible, bevel joints for full weld penetration.
- ❑ The gap between the adapter and the cutting edge should be as small as possible to minimize residual stresses in the weld.



Preheating recommendations



- Check the preheating requirements of both adapter and cutting edge.
- The preheating table is based on single plate thickness
- The entire adapter as well as the cutting edge, extending 75 mm from the adapter, should be preheated to the highest of the recommended preheat temperature given by the adapter/cutting edge.
- Apply heating from the side opposite to be welded.
- Check the temperature on the side to be welded
- Prevent hardness loss in cutting edge, by not exceeding temperatures of 200-250 °C.
- Do not preheat the entire length of a cutting edge already welded into a bucket. Thermal expansion of the cutting edge may cause cracking in the rear cutting edge weld

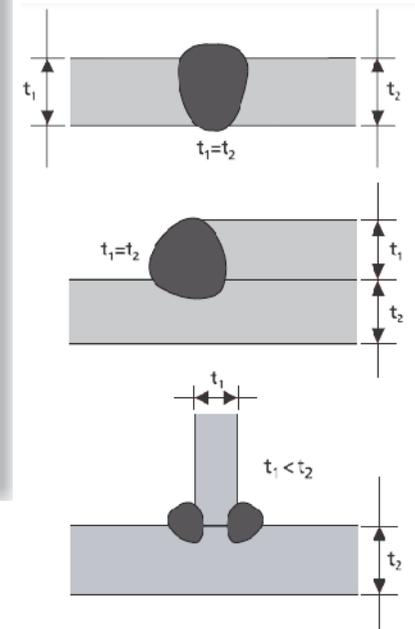
Preheat requirements of HARDOX



Minimum recommended preheat and interpass temperatures for different single plate thicknesses (mm)

	3	10	20	30	40	50	60	70	80	90	120	130
WELDOX 700	Room temperature	Room temperature	Room temperature	75°C	75°C	100°C						
WELDOX 900*	Room temperature	Room temperature	75°C	75°C	100°C							
WELDOX 960*	Room temperature	Room temperature	Room temperature	100°C								
WELDOX 1030*	Room temperature											
WELDOX 1100*	Room temperature	Room temperature	75°C	125°C								
WELDOX 1300*	Room temperature											
HARDOX HiTuf	Room temperature	100°C	100°C	125°C	125°C	125°C	125°C					
HARDOX 400	Room temperature	Room temperature	Room temperature	75°C	75°C	100°C	175°C	175°C	175°C	200°C	200°C	200°C
HARDOX 450	Room temperature	Room temperature	Room temperature	125°C	125°C	150°C						
HARDOX 500	Room temperature	Room temperature	Room temperature	175°C	175°C	200°C						
HARDOX 550	Room temperature	Room temperature	Room temperature	175°C	175°C	200°C						
HARDOX 600	Room temperature	Room temperature	Room temperature	175°C								
HARDOX 600 Stainless steel consumables	Room temperature	Room temperature	Room temperature	100°C								

■ Room temperature (approx. 20°C)
 Outside the size range
 ■ Only stainless steel consumables
 Preheat and interpass temperature at least 100°C



Welding consumables



- ❑ Use soft welding consumables with a yield strength below 500 MPa. Such welding consumables reduce the residual stress level in the joint and thus the sensitivity to form hydrogen cracking.

- ❑ If welding with MMA or FCAW, basic flux electrodes should be used giving a hydrogen content less than 5 ml/100 g weld metal.

- ❑ If preheating can not be applied austenitic filler material could be utilized (Type AWS E(R) 307 or AWS E(R) 309).

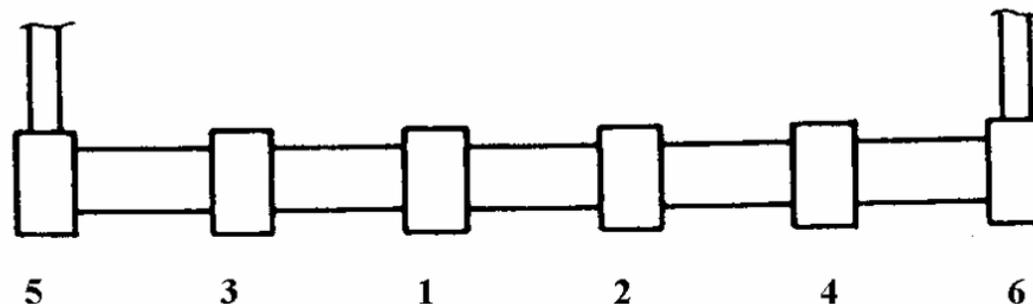
- ❑ If welding adaptors made of manganese steel to a cutting edge in HARDOX wear plate, austenitic consumables shall always be used.

- ❑ Recommended consumables for welding of HARDOX are given in [TechSupport # 17: Welding consumables](#)



General Weld Procedure

- ❑ To reach the best weld quality, perform welding in the horizontal position.
- ❑ Both adapter and cutting edge should be preheated if preheating is required.
- ❑ Do not forget preheating prior to tack welding.
- ❑ Start welding in the mid section of the cutting edge and continue out to the ends
- ❑ Use a large number of passes with less weld deposit to fill the groove.
- ❑ Provide a good weld fusion between adapter and cutting edge. Incomplete fusion may result in underbead cracking.
- ❑ After finished the welding, put thermal insulation on the cutting edge for slow cooling



Welding Sequences for Teeth Adapters



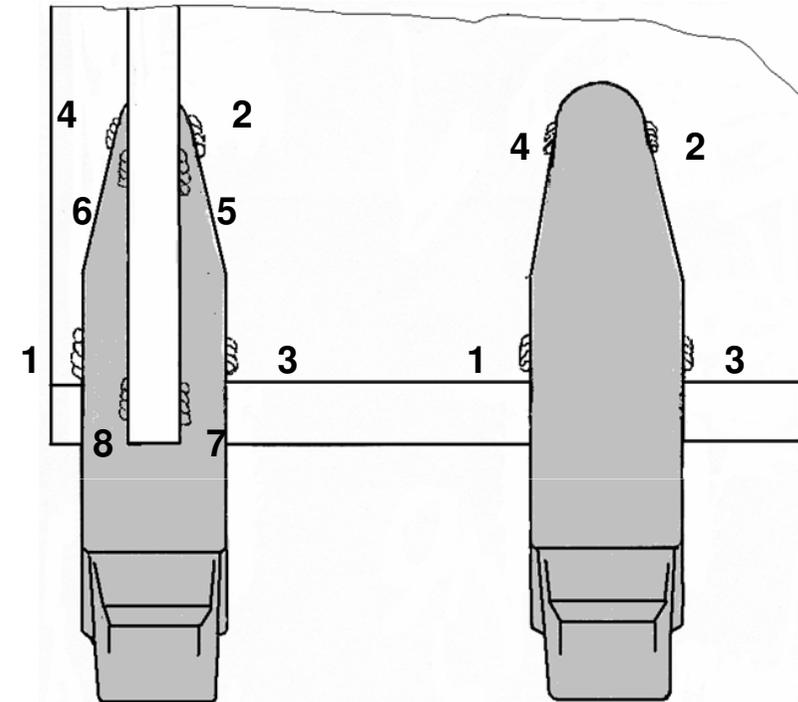
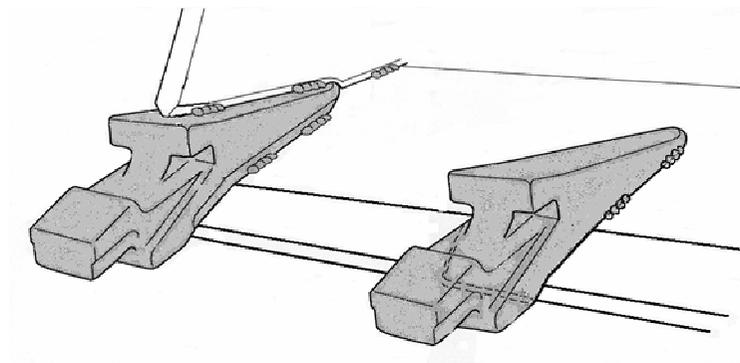
- ❑ To minimize the residual stresses in the welds, the adapters should be welded following the welding sequences recommended by the manufacturer of the adapter.

- ❑ Proposals for suitable welding sequences for different types of adapters are shown in the following context.



Flush Mounted Adapter- Tack Welding

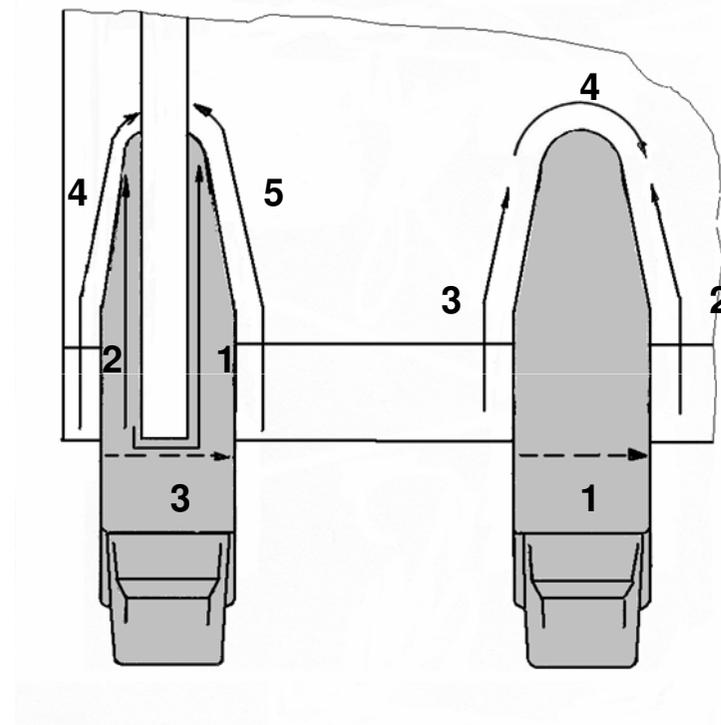
- ❑ If preheating is required, preheat both cutting edge and adapter before tack welding
- ❑ Use weld sequences as shown in the picture
- ❑ Minimum length of the tack welds should be 50 mm



Flush Mounted Adapter- Weld Sequences



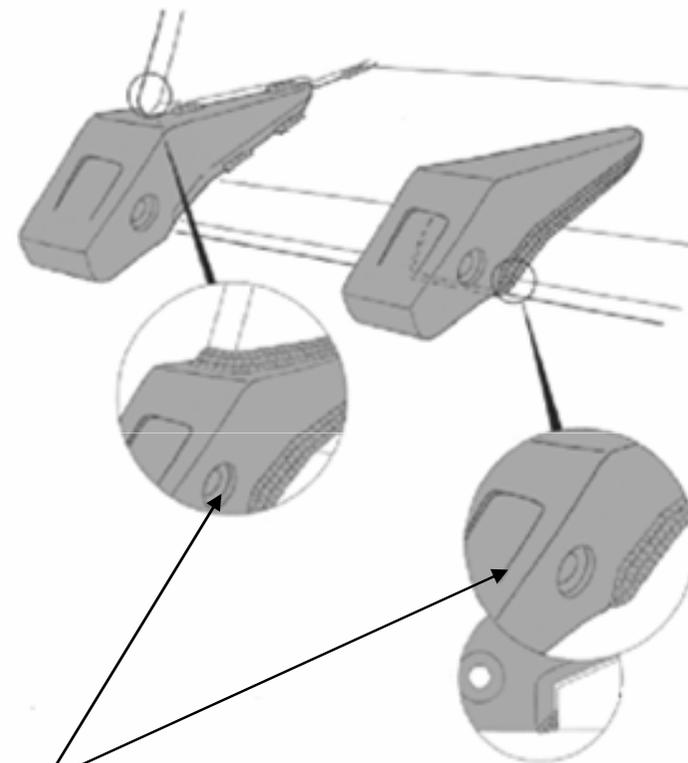
- ❑ Weld the adapter according to the sequences shown in the drawing.
- ❑ Recheck the temperatures of both pieces 75 mm from weld area prior to each pass. Reheat if temperature drops below recommended values.





Flush Mount Adapter- Critical zones

- ❑ If possible, avoid to weld in the critical zones. Start the weld 15 to 25 mm from the edge of the blade.
- ❑ If welding is necessary, do not start or finish welding in the critical zones. Starts and stops are the most susceptible to cracking
- ❑ The surface and toes of the welds in the critical zones should be ground smooth

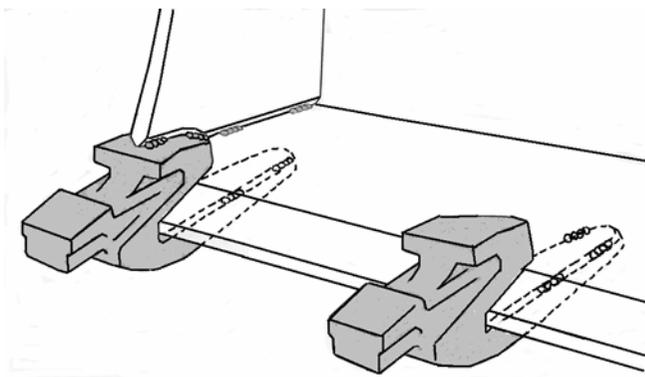
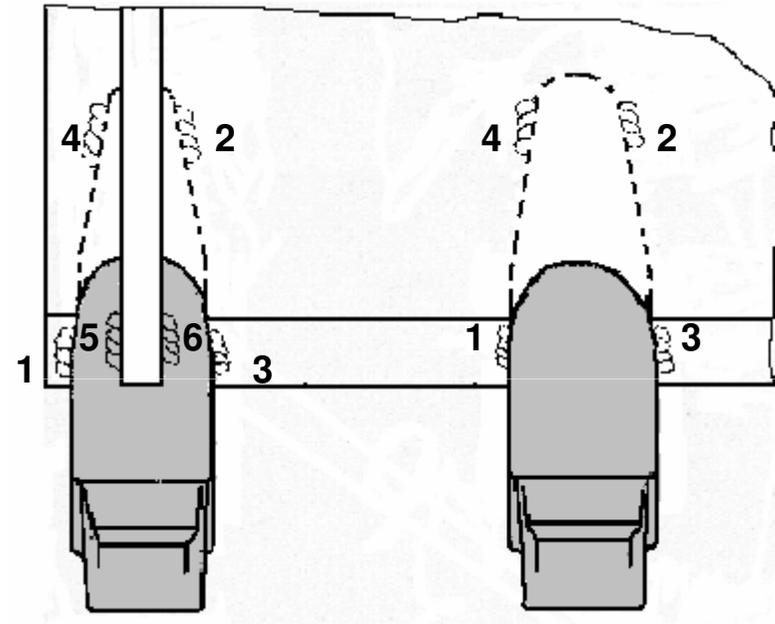


Critical zones

Bottom Strap Adapter- Tack Welding



- ❑ If preheating is required, preheat both cutting edge and adapter before tack welding
- ❑ Use weld sequences as shown in the picture
- ❑ Minimum length of the tack welds should be 50 mm



Bottom Strap Adapter- Welding Sequences



- ❑ Complete all welding on the bottom side of the edge first. Follow welding sequences as shown in fig 1.
- ❑ Turn the base cutting edge over and complete all the welding on the top side using the weld sequences shown in fig 2.
- ❑ Recheck the temperatures of both pieces 75 mm from weld area before each pass. Reheat if temperatures drop below recommended values.

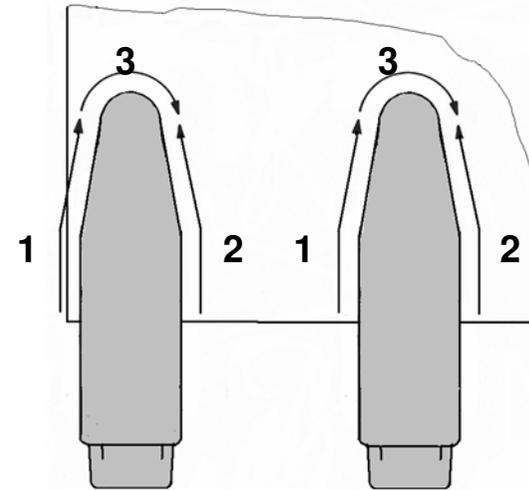


Fig 1

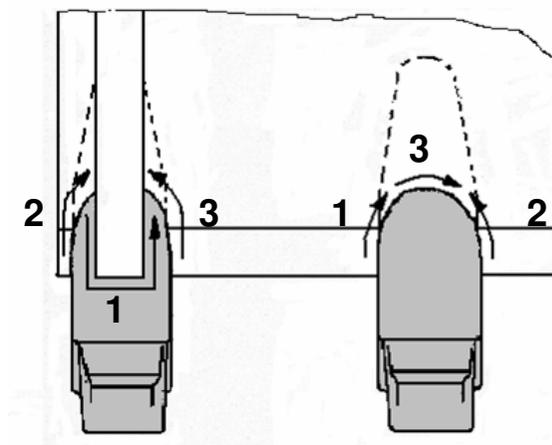
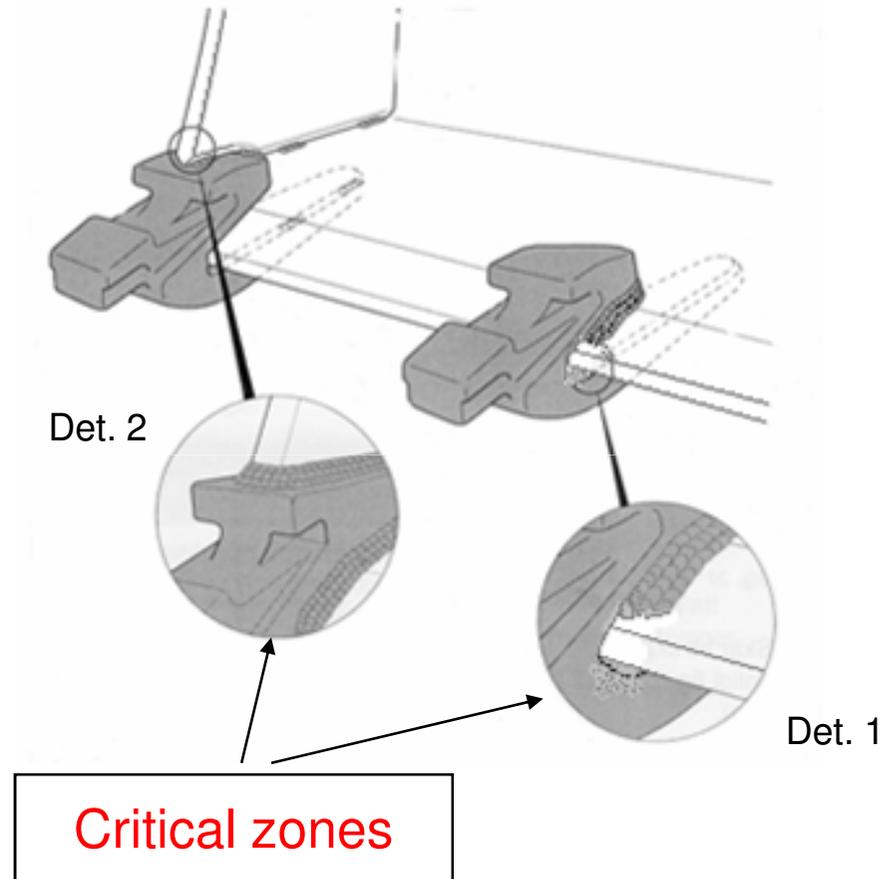


Fig 2



Bottom Strap Adapter- Critical Zones

- ❑ If possible, avoid to weld in the critical zones. Start the weld 15 to 25 mm from the edge of the blade, see detail 1.
- ❑ If welding is necessary, do not start or finish welding in the critical zones. Starts and stops are susceptible to cracking.
- ❑ The surface and toes of the welds in the critical zones should be ground smooth
- ❑ Important to achieve full penetration in the joint between side edge and the adapter, see detail 2.



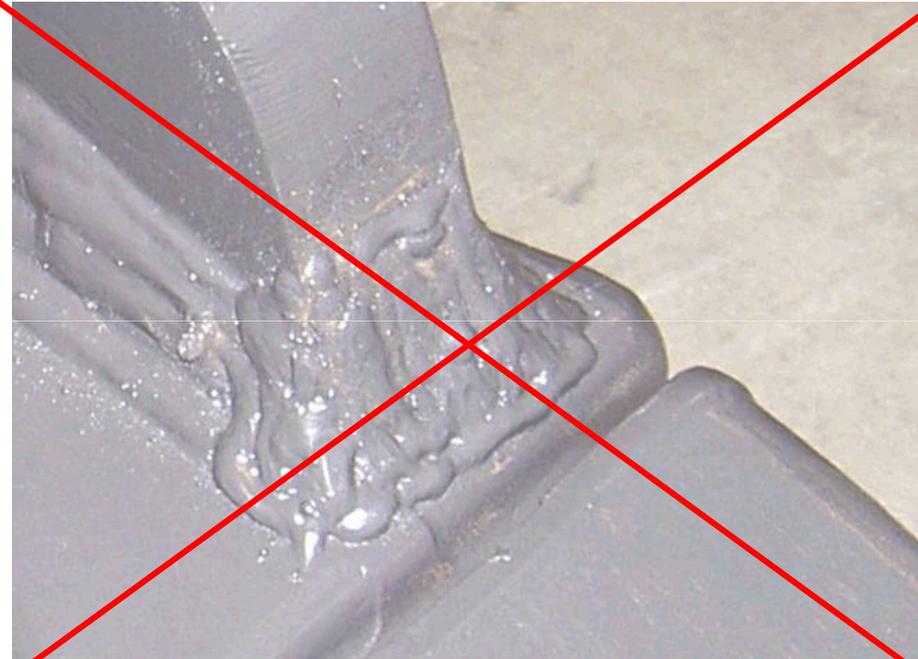
Welding in the critical zones



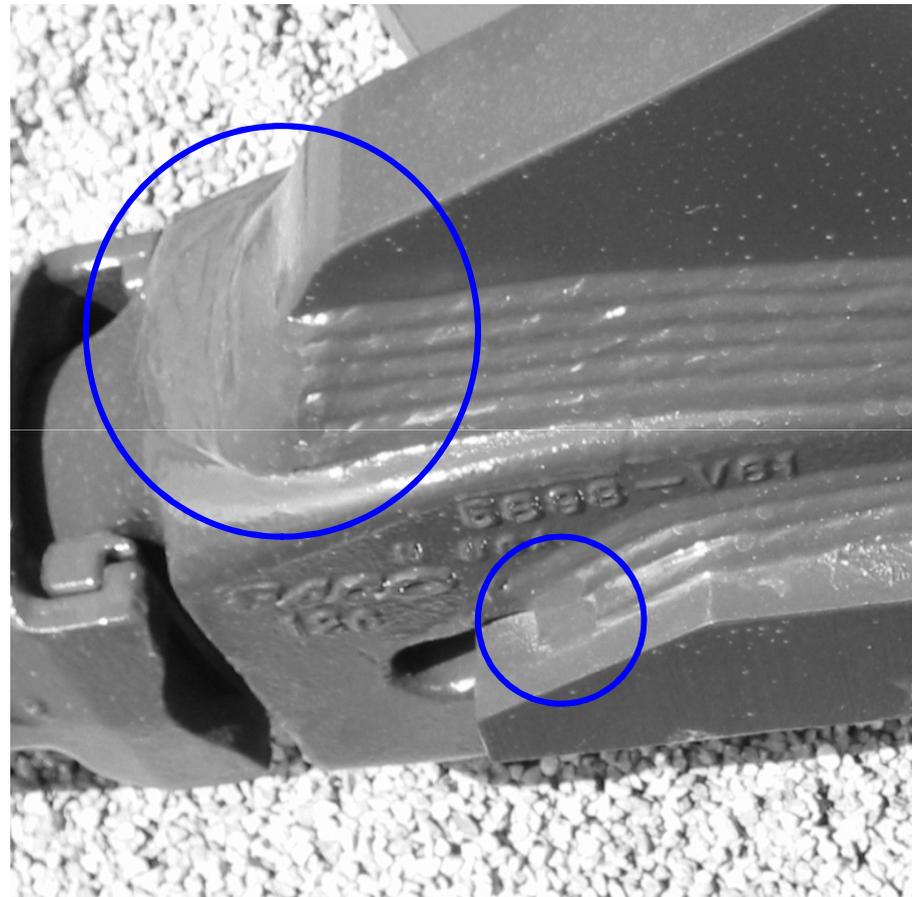
Right



Wrong



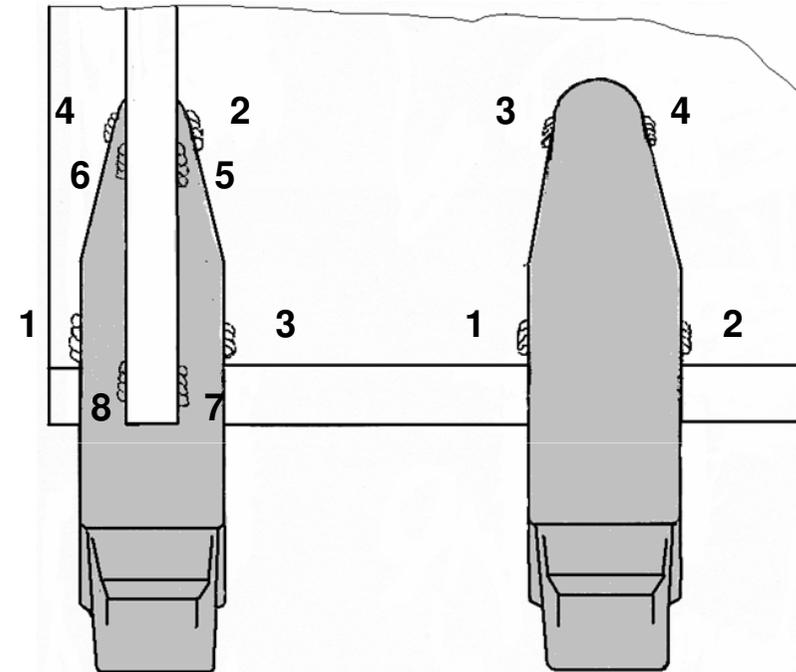
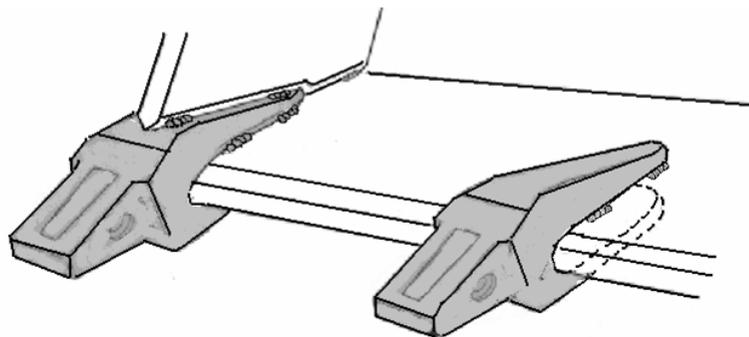
Grinding of the weldment in the critical zones



Top Strap Adapter- Tack Welding



- If preheating is required, preheat both cutting edge and adapter before tack welding
- Use weld sequences as shown in the picture
- Minimum length of the tack welds should be 50 mm





Top Strap Adapter- Welding Sequences

- ❑ Complete all welding on the top side of the edge first. Follow welding sequences as shown in figure 1.
- ❑ Turn the base cutting edge over and complete all the welding on the bottom side using the weld sequences shown in figure 2.
- ❑ Recheck the temperatures of both pieces 75 mm from weld area before each pass. Reheat if temperature drops below recommended values.

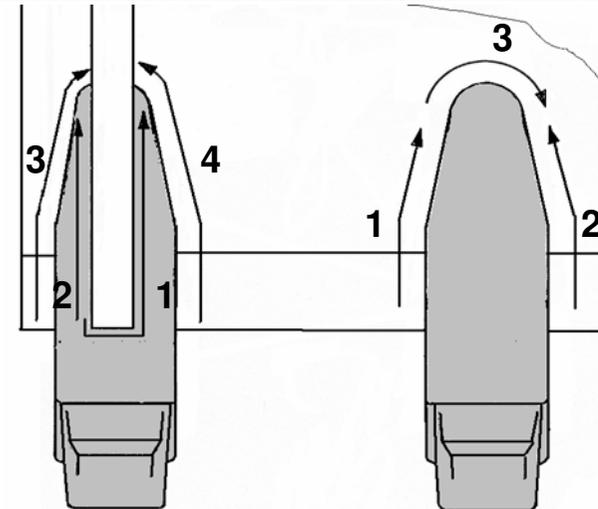


Fig 1

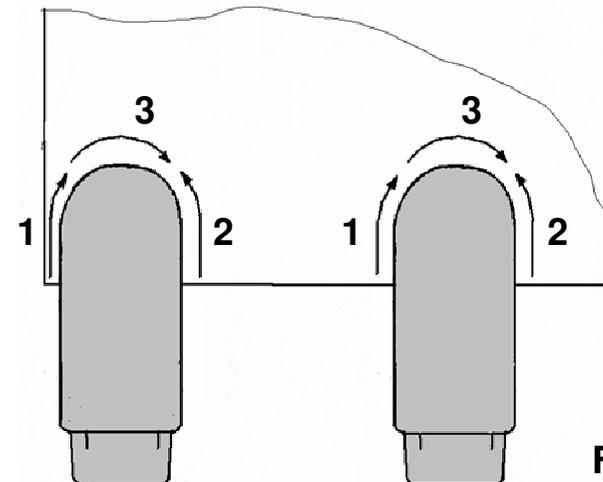


Fig 2

Top Strap Adapter- Critical zones



- ❑ See Bottom Strap Adapter- Critical Zones

Welding of the rear of the adapter- “Fish tail”



- ❑ Some of the adapter manufacturers recommend extending welds to a minimum of 25 mm beyond the rear of the adapter, instead of welding around it.





Welding of the Cutting Edge to the Shell

- ❑ Use preheating if necessary. Preheat also before tack welding.
- ❑ Start to weld in the middle and continue out to the free edge, Fig 1
- ❑ Avoid welding at the centre of plate of the cutting edge, Fig 2.

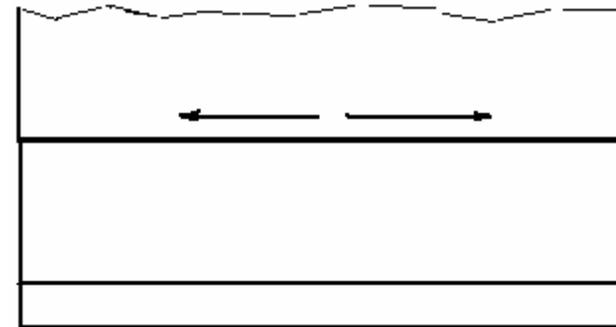


Fig 1

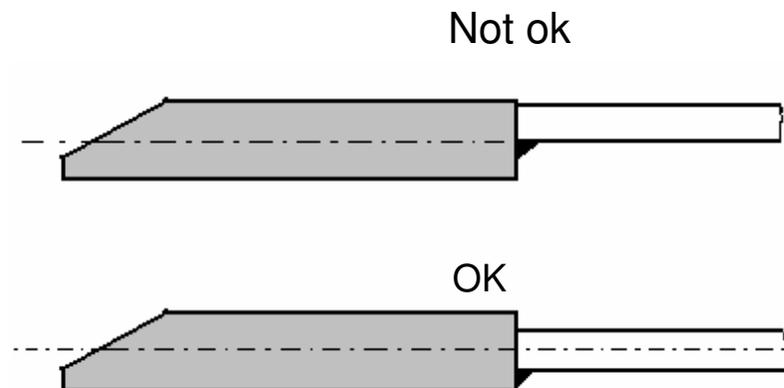


Fig 2

Assembling procedures



Two ways to weld the cutting edge and adapters to the bucket. Advantages and disadvantages

- ❑ **Welding of cutting edge to the bucket prior to welding of adapters**
 - + Easier to centre the corner adapters against the side cutting edges.
 - + Easier handling in the workshop
 - Preheating of the entire cutting edge can not be performed due to the thermal expansion of the cutting edge that may cause cracking in the rear cutting edge weld
 - Increased residual stress levels in the cutting edge and rear cutting edge weld

- ❑ **Welding of adapters to the cutting edge prior to welding edge to bucket**
 - + The entire cutting edge can be preheated (in furnace), which increases productivity.
 - + Less stresses will be accumulated in the cutting edge and rear cutting edge weld
 - More difficult to centre corner adapters against the side cutting edges.
 - More difficult handling in the workshop

Summary- Welding of Teeth Adapters



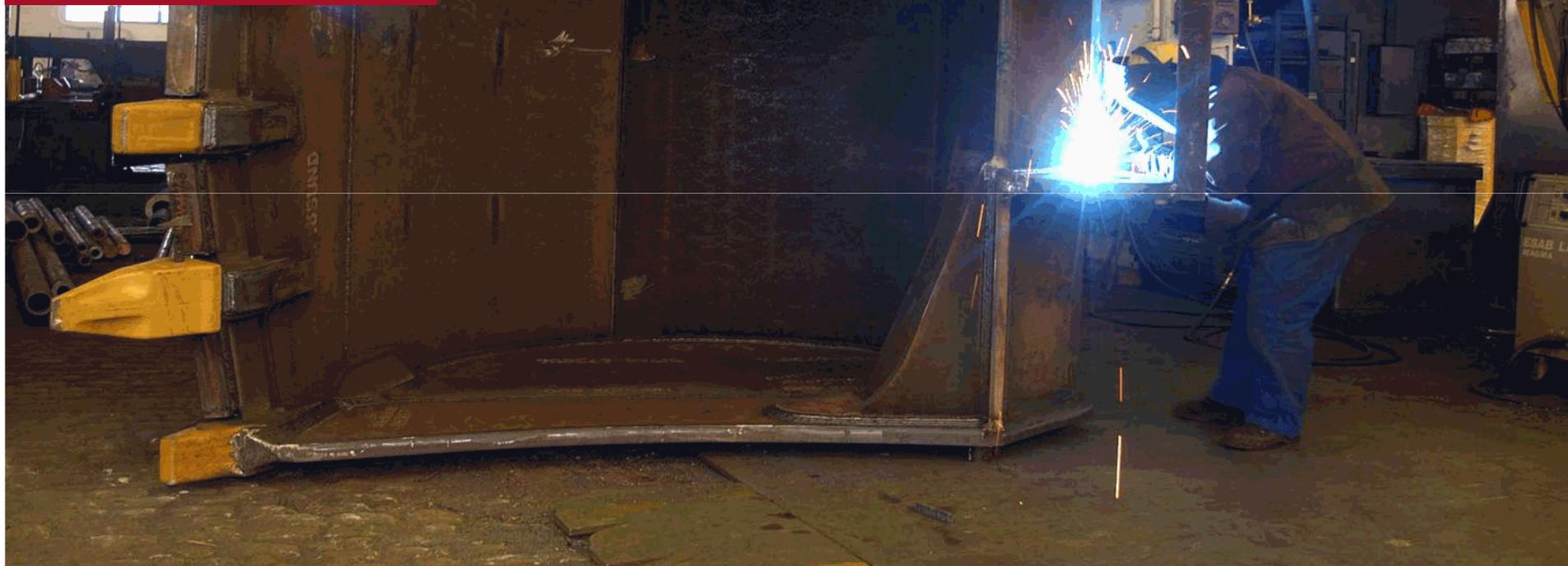
- Choose suitable HARDOX grade for the cutting edge
- Preheat both cutting edge and adapter as recommended
- Preheat before tack welding
- Use dry, low hydrogen consumables of low strength
- Follow the recommended welding sequences
- Pay attention to welding in critical zones

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