

# Saint-Gobain - Coating Solutions

## Technical Training Bulletin

### TUF COTE brazing procedure

(exp)

#### Tuf-Cote Hard-facing flexible cord

#### STEP 1 : Choose the oxygen / acetylene torch nozzle

##### Oxygen – acetylene brazing torch with powder bowl

The choice of the torch is at the convenience of the welder, consider :

- TUF-COTE diameter 8mm, torch is set with nozzle N°4 (Φ 2,2mm) or N°5 (Φ 3,0mm).
- TUF-COTE diameter 6,35mm, torch is set with nozzle N°3 (Φ 1,75mm) or nozzle N°4 (Φ 2,2mm).
- TUF-COTE diameter below 6,35mm, torch is set with nozzle N°3 (Φ 1,75mm).

##### Gas & Oxygen cylinder & pressure regulators (not supplied)

Oxygen and acetylene cylinders are required. Oxygen is set from 2,1 to 4 bars (30 to 60 PSI) & acetylene is set at 0.8 bars (12 PSI).

##### Flexible Cord Holder (not supplied)

Holder should be manufactured with copper tube ID 12mm, the radius of the curve should be between 20 (8") to 30 cm (12").

##### Flexible Cord choice

Make sure that the appropriate flexicord grade and diameter have been chosen correctly.

**TUF-COTE A** : Recommended for severe abrasive wear, corrosion resistant. Recommended for civil works, mining drilling...

**TUF-COTE M/N** : Recommended for severe abrasive & erosive wear from powders or clay, corrosion resistant. Grade M may be ground.

**TUF-COTE F** : Recommended for severe erosive or friction wear from powders, metals, clay..., corrosion resistant. Grade F may be ground.

#### STEP 2 : Preparation of the parts

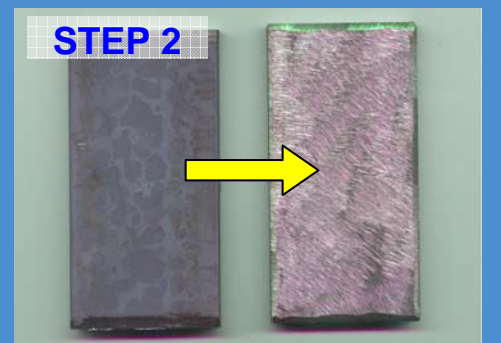
**⚠** The preparation of the part is an important step for the further coating performance and bonding.

- Slight grinding operation or sand blasting operation is necessary before application of the Tuf-Cote. Surface must be clean and free of : oxidation, grease, surface contamination, old coating...
- All edges must be cut by grinding in order to help edge built-up.



Tufcote diameter (mm/inch)	Tickness of the coating	
	mm	inch
4,75 – 3/16"	2 to 3	0,08" to 0,12"
6,35 – 1/4"	3 to 4	0,12" to 0,16"
8 – 5/16"	4 to 5	0,16" to 0,20"

Data only for information, depends on welder.



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## STEP 3 : Recommendation before brazing

- The welder should find a comfortable position in order to ensure the homogeneity and accuracy of the Tuf-Cote layer.
- Make sure that the hoses are not exposed to the flame, to the heat from the work-piece and to eventual hot metal particles.
- Install the Tuf-Cote spool on an appropriate support. Do not install the spool in the proximity of a heat source.

## STEP 4 : Under layer with SF NI 40 or SF NI 60

Before brazing TUF-COTE, an under layer 100 to 300µm thick, might be applied, with the torch. The under layer is composed of self-fluxing nickel alloy having a hardness between 40 to 60 HRc.



Advantages of the under-layer:

- Avoids any oxidation of the surface during brazing,
- Prevents chromium migration to the surface (risk of sticking),
- Increases the diffusion between the coating and the substrate,
- Makes the Tuf-Cote deposition easier and progressive,
- Provides higher thickness accuracy.

Preheat the work-piece up to 150° - 200°C, then apply a layer of SF NI 40 or SF NI 60. If required, the under layer is fused before brazing.

*Note: For the experimented welders the under-layer may not be required to be fused before Tuf-Cote brazing : at welder's convenience.*

## STEP 5 : Preheating before brazing

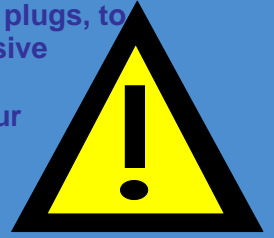
Preheat the work-piece with the torch before brazing Tuf-Cote.

**Low carbon steel:** preheat the work-piece area to 450°C (840°F),  
**Cast iron or Mn steel (Mn%>0,5):** preheat up-to 600°C (1112°F),  
**Other steel:** refer to the recommendation of the steel supplier.

Before starting any hard-facing operation, the welder must consider the thermal mass of the workpiece to be hard-faced, its shape, its composition. When the thermal mass of the workpiece is low, proceed to a local preheating, the temperature of the workpiece, will increase by it-self, when brazing TUF-COTE.

During the brazing time, the work-piece should be maintained at the appropriate temperature, in order to prevent excessive cracking or damages at the coating's interface with the work-piece.  
For the largest size an additional torch or burner is required.

- Work in a sufficient ventilated area,
- Use dark glasses (level 5) for the optimal process view and eyes protection,
- Wear non-flammable cloths,
- Wear ear plugs, to avoid excessive noise,
- Wash your hand after brazing.

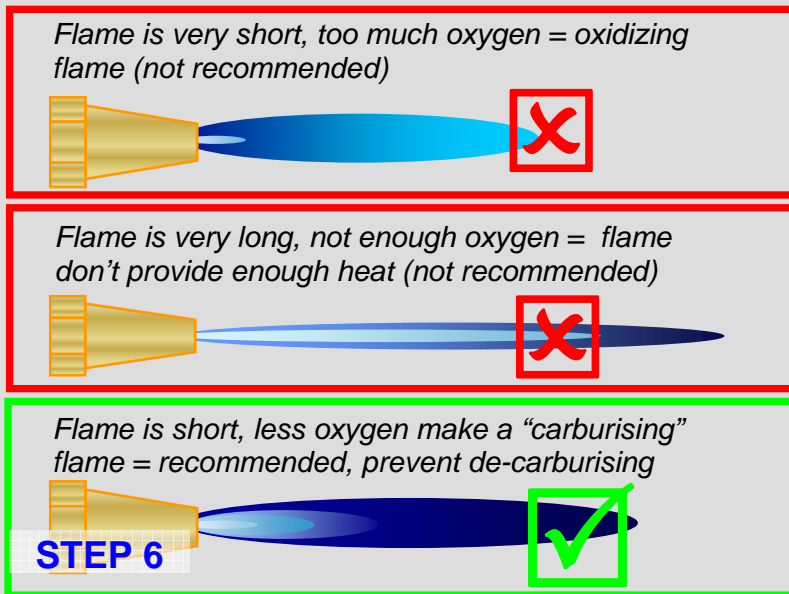


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## STEP 6 : Setting of the torch flame parameter

The flame should be adjusted to bring enough energy, by limiting the work-piece oxidation. The flame must not over-heat the work-piece.

Adjust a stoichiometric flame setting : neutral flame or carburising flame.




## STEP 7 : Brazing

Before beginning the job, pay attention to what will be the start-point and the end-point of the welding operation. Tuf-Cote will be easier to be weld with a motion parallel to the main axis of the work-piece. The advantage is to reduce the number of start-points and end-points, which are critical for the coating shape and metallurgy.

- Insert the Tuf-Cote flexible cord in the holder. A length of 10 to 15 cm (4 to 6") should be out the holder.

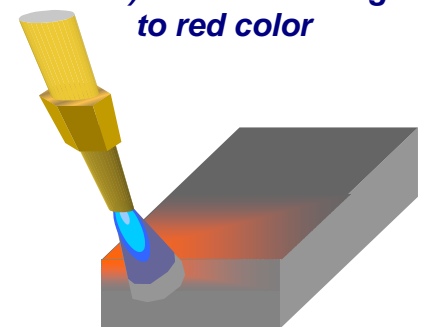
**STEP 7.a)** With the torch, preheat locally the edge of the work-piece, up to red color at 600°C (1112°F).

**STEP 7.b)** Apply droplets of Tuf-Cote on the edge, and build up the width of the 1<sup>st</sup> pass. The thickness should be reached in one pass. The stand-off between the torch and the pool of TUF-COTE should be 5 to 10mm. Apply Tuf-cote on a surface of 25mm x 10mm (1" x 1/2").

 Do not overheat the tungsten carbides particles, it will affect the life-time of the Tuf-Cote coating.

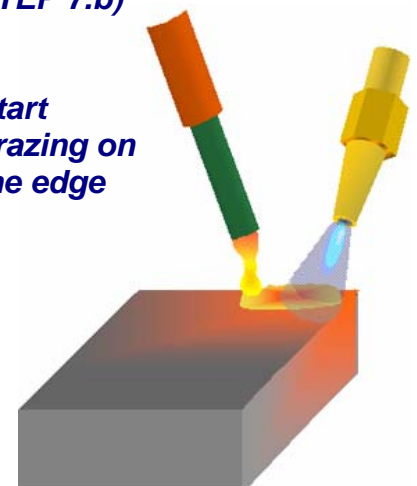


### STEP 7.a) Preheat the edge to red color



### STEP 7.b)

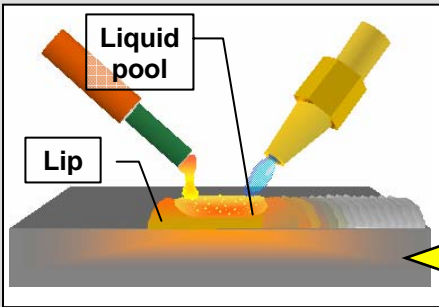
**Start brazing on the edge**



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**STEP 7.c)** Create a pool of molten metal. Feed Tuf-Cote in order to create an area of molten metal 25 x 25mm (1" x 1"). If required, stop feeding Tuf-cote and make sure that the pool is totally liquid.

- ⚠ The flexi-cord must not be directly in contact with the pool.
- ⚠ The hot zone of the flame should not be in contact with the pool.
- ⚠ Control the flame power and re-adjust according to your need.



**STEP 7.d)** When the pool is liquid, start the progression of the coating, by pushing the pool "with" the flame of the torch.

- ⚠ The liquid pool must be located behind the lip of the coating.

The torch flame must form an angle of about 45° with the workpiece surface, as well as the Tuf-Cote cord at the opposite angle. The coating formation must be continuous and smooth. For that, the flame must swing according to an horizontal and elliptic movement at the surface of the pool.

- ⚠ Never have a pull movement of the torch to weld Tuf-Cote.

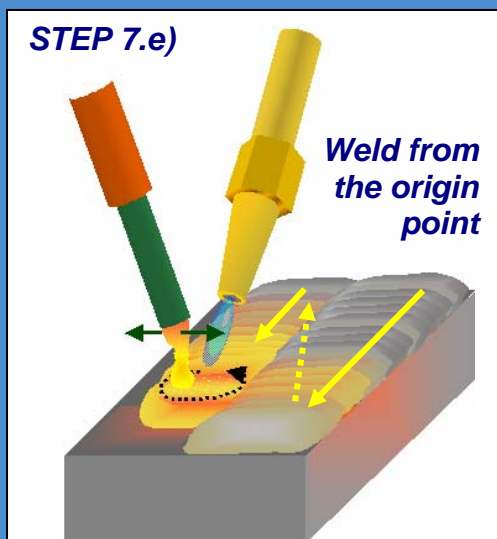
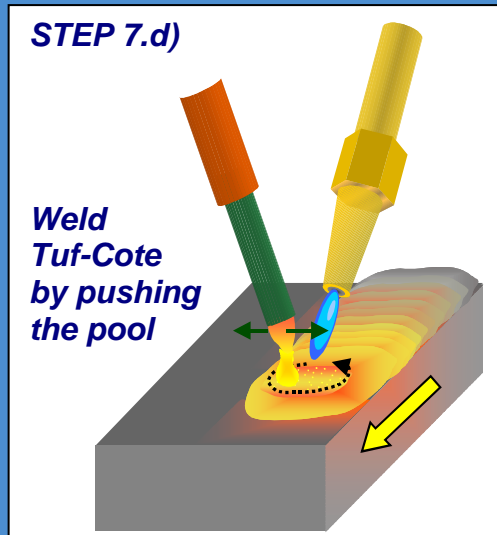
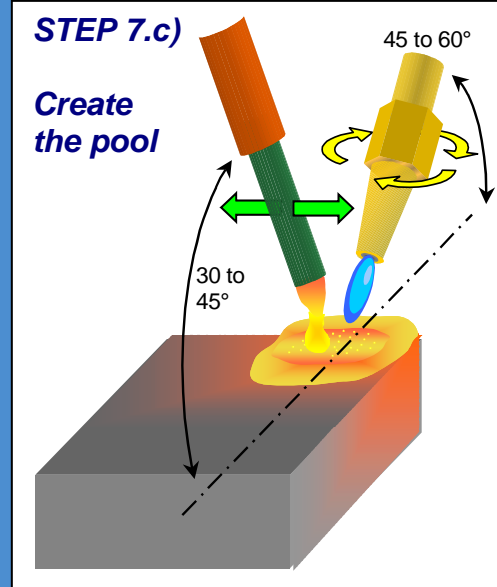
Feed the Tuf-Cote flexi-cord regularly to the pool through the holder (4-6" at a time). The tip of the cord should not be lowered or lifted during the brazing. When you feed again the Tuf-Cote through the holder, heat the pool with the torch again.

⚠ If the work-piece gets too hot during brazing, and it's difficult to stabilize the pool, then; decrease the angle of the torch and increase the angle of the flexi-cord, it will increase the deposition rate.

⚠ If the pool is too cold, remove the flexi-cord out of the heat zone, and heat the pool again until it is liquid. If the pool is not significantly liquid, you will have a bad diffusion between the Tuf-Cote layer and the part to be hard-faced, or the distribution of WC particles will be not homogenous inside the TufCote layer.

**STEP 7.e)** If a second layer of Tuf-Cote is required, begin from the same origin side as for the first layer. Fuse the side of the first welded layer. When finishing a layer, maintain a large and smooth pool of molten metal during a few seconds: it will increase diffusion.

⚠ If a butt of Tuf-Cote falls inside the bath, continue to heat this area carefully, because probably some porosity is hidden behind an agglomeration of tungsten carbides.



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## STEP 8 : Cooling

*Tuf-Cote has a different thermal coefficient of expansion compared to most of the steels.*

Cooling should be homogeneous, slow and without cold air stream. If required, you must use insulation granulate or rock wool to cool the larger work-piece slowly.

Slow cooling will reduce the internal stresses and thus decreases the risk of cracking inside the coating or at the interface or at the surface of the work-piece.

- The work-piece must be considered as hot, until the internal temperature is at room temperature.
- For the work-pieces made from cast iron or manganese steel, a post heating is required and a controlled down-ramp control of temperature is required. The ramp-temperature and the speed of cooling must follow the steel manufacturer recommendations.
- For the work-pieces with a low thermal mass and a simple shape, air cooling should be sufficient.

 Cracks can appear in the coating. This phenomena depends on the base material and the size of the work piece. The cracks help to release the internal stresses. If the cracks are not parallel to the surface, they are not detrimental to the coating life-time. Follow-up the recommendation of the steel supplier.

## Additional comments – Usual recommendations

- If the flexible cord is not required to be fed inside the pool, you must remove the holder from the flame area.
- Never let the tip of the flexible-cord burn, it will cause the butt to fall.
- The welding procedure should take into account the thickness of the coating to provide a maximum wear resistance. Also modify your parameters according to the thermal mass of the work-piece.
- The machining of Tuf-Cote is only possible only with a diamond grinding wheel.
- The movement of the torch must be slow and regular, and should follow an elliptic movement. This slow movement will guarantee a coating free of porosity and the usual metallurgical defects.
- For Tuf-Cote d8mm grade A with a #5 torch, the maximum deposition rate is about 2Kg/hour (4,2 Lbs/hour) and can reach 3,5Kg/h (7,7 Lbs/h).
- The welder should take frequent breaks in order to consume water.

