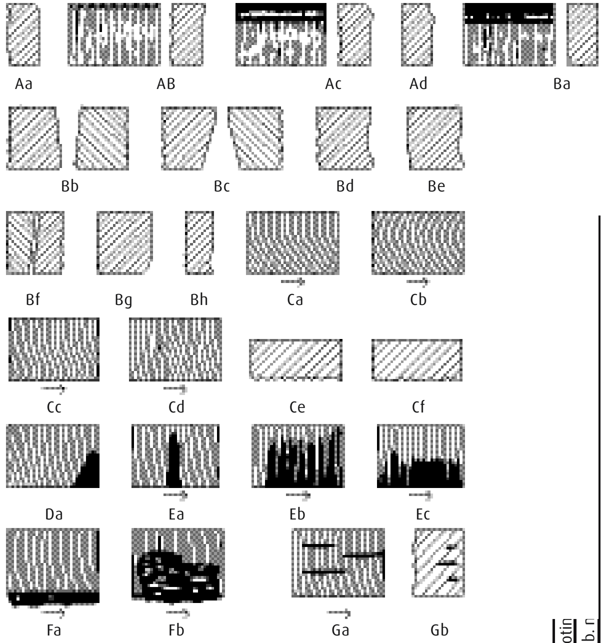
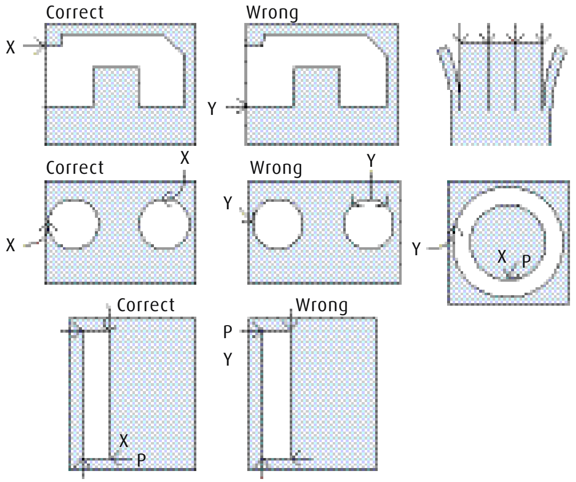


								Heating and cutting nozzles (faults in common)						Heating (outer) nozzle (individual faults)					Cutting nozzle (individual faults)							Plate						Material aspects					
Oxygen cutting		Troubleshootin	01 Position of b. n	02 Position of b. not rectangular with respect to work surface	03 Excessive blowpipe travel	04 Travel too slow	05 Travel irregular	06 Nozzle-to-plate distance too large	07 Nozzle-to-plate distance too small	08 Nozzles too large for thickness to cut	09 Nozzles too small for thickness to cut	10 Dirty nozzles	11 Nozzles damaged or worn	12 Flame to strong	13 Flame too weak	14 Backfiring	15 Excess fuel gas flame	16 Excess oxygen flame	17 Excessive cutting oxygen flow rate	18 Cutting oxygen flow too low	19 Cutting oxygen flow temporarily discontinued	20 Excessive cutting oxygen pressure	21 Cutting oxygen pressure too low	22 Cutting oxygen jet disturbed	23 Cutting oxygen jet deflected	24 Surface scaled or rusty	25 Surface contaminated (e.g. with paint)	26 Plate with segregations	27 Plate with laps or laminations	28 Plate with slag inclusions	29 Plate with finely distributed enclosures	30 Carbon content too high	31 Alloying elements content too high	32 Steel susceptible to hot cracking	33 Workpiece insufficiently preheated	34 Rapid cooling of workpiece	35 Material strain hardened
A: Imperfections on flame-cut edge	a	Rounded cut edges				■		▨	▨	▨				■				▨																			
	b	Beaded cut edges						░	▨					▨												▨											
	c	Edge overhand				░		░	▨	░				■			░																				
	d	Melted-down top edge with firmly adhering slag						■						▨								■															
B: Imperfections on flame-out faces. Perpendicularity and angularity tolerance.	a	Grooved cut face below top edge						▨				▨										■		▨													
	b	Narrowing kerf (convergent)			■			▨			░	▨												▨													
	c	Widening kerf (divergent)			■			░											▨			■															
	d	Concave cut face			■						▨	▨	▨									░	▨	░													
	e	Wavy cut face profile			■					░		▨	▨										▨	▨													
	f	Angular deflection		■																					▨												
	g	Rounded bottom edge			▨							■	■									▨		■													
	h	Grooved face above bottom edge			■							■	■											■													
C: Imperfections on flame-cut faces. Deviations from drag line pattern.	a	Excessive backward inclination of drag lines			■			░			▨									▨			▨														
	b	Forward inclination of drag	■									▨	▨											▨													
	c	Excessive forward inclination of drag at bottom										■	■											■	▨												
	d	Local drag line deflection					▨																					■		■	■						
	e	Excessive depth of drag lines			■		■		▨					▨																			▨				
	f	Irregular depth of drag lines			■		■								▨																						
D: Imperfections on flame-cut faces: Lost cut	a	Bottom section not severed			■																																
	b	Interrupted cutting action			■			▨			■	■	■		■	░				▨				■		▨	■	▨	■	▨	░						
E: Gouging	a	Isolated													░	■					■					■	■				▨						
	b	Accumulated			■				▨						▨											■	■										
	c	Gouging especially in bottom part				■						▨	▨		░									▨													
F: Adhering slag	a	Slag adhering to bottom edge			■	■		░			■			░			▨						■			▨	▨										
	b	Crust of slag																															■				
G: Cracks	a	In the cut face																														■	■	■	■	■	■
	b	Below the cut surface																														■	■	■	■	■	■

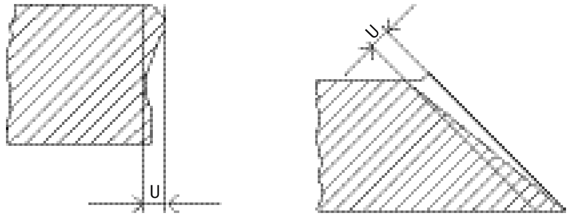
■ First-order causes of defects ▨ Second-order causes of defects ░ Third-order causes of defects



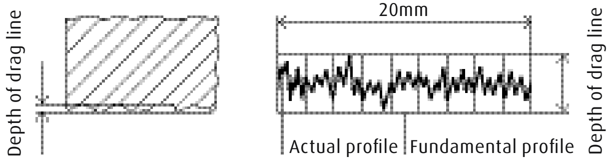
5. Cut quality

Quality classification of flame-cut faces are standardised to EN ISO 9013, e.g.:

→ Perpendicularity and angularity tolerance, u (former unevenness)



→ Ten-point height of irregularities, Ry5 (former depth of drag line)



See table for faults and defects in oxygen cutting (and possible causes).

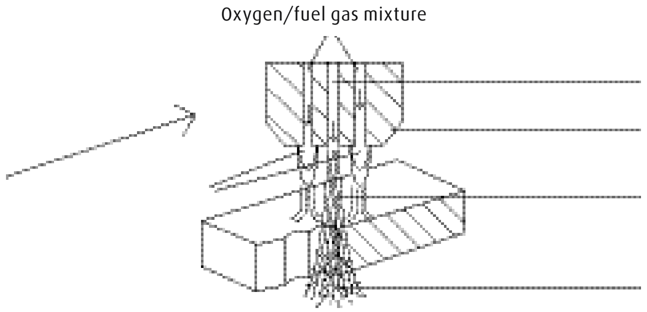
Linde AG
Linde Gases Division, Seitnerstrasse 70, 82049 Pullach, Germany
Phone +49.89.7446-0, Fax +49.89.7446-1230, www.linde-gas.com

1110 – 1.X L&P Subject to change.

THE LINDE GROUP
Linde

Tips for the practitioner.
Oxygen/fuel gas cutting.

1. Fundamentals of the process



Oxygen/fuel gas cutting is a process in which the base metal is heated to its ignition point by a heating flame and then burned by a jet of oxygen. Moving the blowpipe across the workpiece produces the kerf. The cutting oxygen (minimum purity 99.5%) will oxidise the metal only when it is heated to its ignition temperature (below the melting point). The ignition temperature is mainly dependent on the alloying elements in the base metal. Common structural (mild) steel containing up to approx. 0.3% carbon is well suitable for oxygen cutting. Preheating may be required in special cases to avoid cracking or hardening at the cut face. For some materials, special processes, e.g. powder cutting, may be applied.

2. Equipment and supplies

Manual gas cutting

The blowpipes used here employ injector or low-pressure type mixers, where the high-velocity oxygen is used to aspirate the fuel gas. The cutting nozzles used on sheet metal are step-type nozzles. The nozzles used for heavier material are annular, slot, or block-type. Manual cutting blowpipes without injector, of the nozzle mixing type, can also be recommended. These are particularly resistant to flashback. Cutting oxygen pressures are usually in the range of up to 6bar maximum. Consult the cutting chart or manufacturer´s data for the correct working pressure. Nozzle design and oxygen pressure at the blowpipe are tuned to one another. In the case of decreasing pressure, e.g. long hose lengths, it is therefore recommended to select pressures above the values given in the cutting chart.

Machine oxygen cutting

Blowpipes for cutting machines can also be of the aspirator type, using an injector and neck, where acetylene and heating oxygen are mixed and carried to the cutting nozzle, or nozzle-mix type blowpipes.

There are various types of machine cutting nozzles:

Standard nozzles	For oxygen pressures of up to approx. 6bar
High-speed cutting nozzles	For oxygen pressures of up to approx. 8bar
Heavy-duty cutting nozzles	For oxygen pressures of up to approx. 11bar

Please ensure:

- → That nozzles are always in good condition.
- → That proprietary nozzle cleaners are used for nozzle cleaning. Never use a wire reamer or drill.
- → That sufficient acetylene, heating and cutting oxygen is supplied to the cutting nozzle, suitable for the material thickness to be cut.
- → That the pressures recommended in the data charts are available at the blowpipe inlet ports – attach check (pressure) gauges if necessary.
- → To maintain the tracks of the cutting machine – check travel speed for lengthwise and transverse motion.

Beware of pressure drops that can result from:

- → Insufficient size of hose diameter or excessive hose lengths.
- → Undersized pressure regulators and shutoff valves.
- → Undersized safety devices or unnecessary ones.

3. Equipment operation

Consult the cutting chart to find the proper operating parameters for the cutting nozzle selected. Set gas pressures with the valves open – attach check gauges.

Adjustment of heating flame:

1. At first, fully open the heating oxygen valve at the blowpipe.
2. Slightly open the acetylene valve.
3. Light the mixture using correct lighter (not matches or cigarette lighter).
4. Increase acetylene flow until excess acetylene has been obtained.
5. Now decrease the fuel gas until a neutral flame is obtained.
6. Open the cutting oxygen valve. Readjust if necessary to obtain neutral flame.

The cutting oxygen must leave the nozzle straight and cylindrically. It shall not flutter. The heating flame shall form a concentric envelope around the oxygen jet.

Select the correct cutting speed using the cutting chart (not reproduced here)

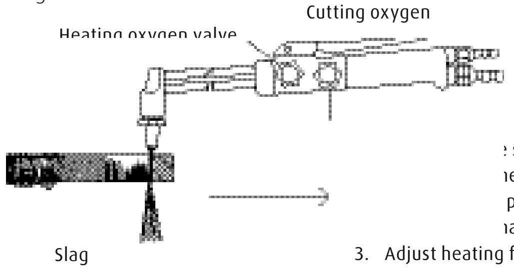
The cutting speed is determined by:

- → The type of cut (square or bevel), straight-line or profile cut.
- → Bevel and profile cutting within narrow radii require reduced travel speed rates, i.e.:

30° bevel cut	By approx. 25%
45° bevel cut	By approx. 45%
Profile cut	By approx. 10%

- → The cut surface quality requirements – structural shapes for subsequent further processing, or mere severing.
- → The material composition.
- → Surface preparation and condition (shot-blasted, scaled, rusty, or primered).
- → The characteristics (smoothness of travel) of the cutting machine.
- → Size and shape of the cutting nozzle.

The cutting operator may also keep to the following procedure diagram:



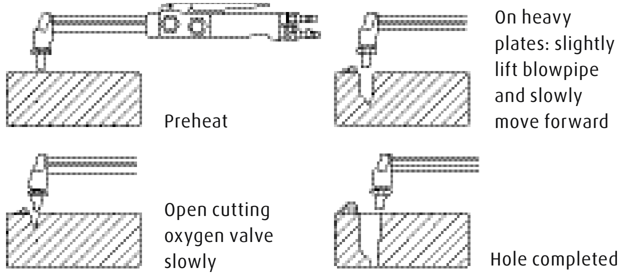
suitable for
ess to be cut.
pressure
art data.

3. Adjust heating flame with the cutting oxygen valve open.

4. Cutting procedures

Start cut by piercing

a) Manual piercing

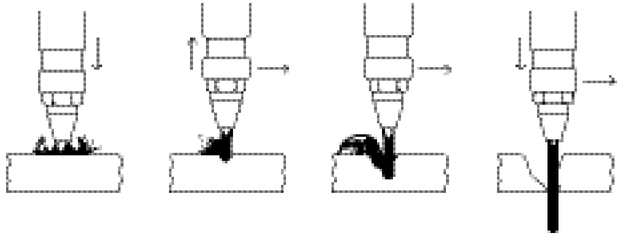


b) Semi-mechanized piercing (manual control)

- → Adjust proper nozzle-to-work distance following the cutting chart.
- → As soon as ignition temperature has been obtained (reddish yellow colour, slight, bright sparking), switch on machine advance and slowly open cutting oxygen valve (dosing valve).

c) Automatic hole piercing

- → Enter data from the hole piercing chart into the machine.



Course of cut and cutting sequence

Appropriate course and sequence of cutting will help reduce distortion caused by heat input from the heating flame. Follow the steps:

1. Perform inside cuts first.
2. The intended line of cut should be such that the scrap parts are allowed to slip off.
3. The section to be cut out should be joined to the base plate as long as possible.
4. Use a workpiece frame for cutting.