LASER cutting

A Member of The Linde Group

If you are not getting a good cut from your laser, you may be experiencing any of the following:

Troubleshooting checklist

Check and correct	Time required (mins)
A Nozzle contamination	1–2
B Laser power and pulsing conditions	1–5
C Cutting speed	1–2
D Cutting gas	1–2
E Nozzle-material standoff	1–2
F Nozzle type, condition and alignment	1–10
G Material specification and condition	1–5
H Lens type, condition and alignment	10–20
I Beam steering mirror condition and alignment	5–60 per mirror
J Laser mode quality and polarisation	20–40

A. Nozzle contamination

Dirt or spatter on the nozzle may deflect the gas jet to one side

→ Wipe the nozzle or replace if damaged

B. Laser power and pulsing conditions

1. Compare laser power and pulse settings to those used successfully on similar jobs
2. If power level is lower than usual:
   → The laser may need time to warm up (up to 30 mins)
   → The helium supply is running low
   → The laser needs tuning
   → The laser needs servicing

E.g. internal mirrors need to be cleaned

Requires trained personnel

C. Cutting speed

Compare cutting speed to those used successfully on similar jobs

→ Try increasing and decreasing the speed by 10% and 20%

D. Cutting gas

1. Check the type of gas being used against similar successful jobs
2. Check supply pressure and flow
   → Nozzle blockages will affect pressure and flow
   → It is best to have both a flow meter and a pressure gauge
   → Excessive oxygen pressure results in burning of corners and loss of fine details
3. Insufficient gas purity or gas supply contamination
   → Contact your gas supplier
   → Oxygen cutting: cutting speed reduced
   → Nitrogen cutting: surface quality reduced

E. Nozzle-material standoff

Compare to earlier successful results

→ Normally the standoff is 0.25–2 mm

→ Changing non-identical nozzles may change standoff
Alter nozzle-lens distance to reoptimise process

F. Nozzle type, condition and alignment

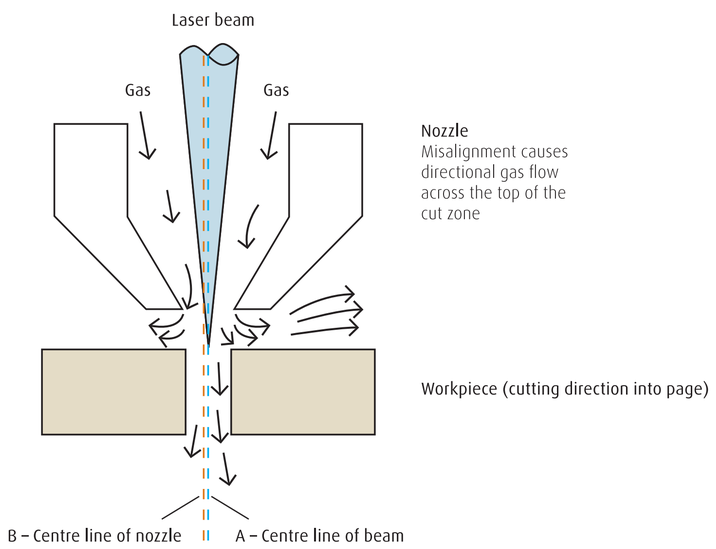
1. Is the nozzle of the right type (exit diameter) for the job?
2. Is the nozzle worn or scratched?
3. Is the laser in the centre of the nozzle (i.e. centre of the gas jet)?

If not:

→ The machine will not cut equally well in all directions

→ Sparks may exit top of the cut zone when cutting in certain directions

→ Reduction of sparks leaving the bottom of the cut when cutting in certain directions



G. Material specification and condition

1. What is the material?
2. Is the condition of the material affecting the cutting?
   → Surface coating (rust, paint, mill scale, etc.)
   → Deep scratches

H. Lens type, condition and alignment

1. Is the right focal length lens being used? Is it fitted correctly?
2. Is the lens scratched or dirty? Both can give cutting problems

Even if it is clean it may have become over-heated

3. Is the laser beam correctly aligned onto the lens?
   → Beam steering mirrors may need realignment

I. Beam steering mirror condition and alignment

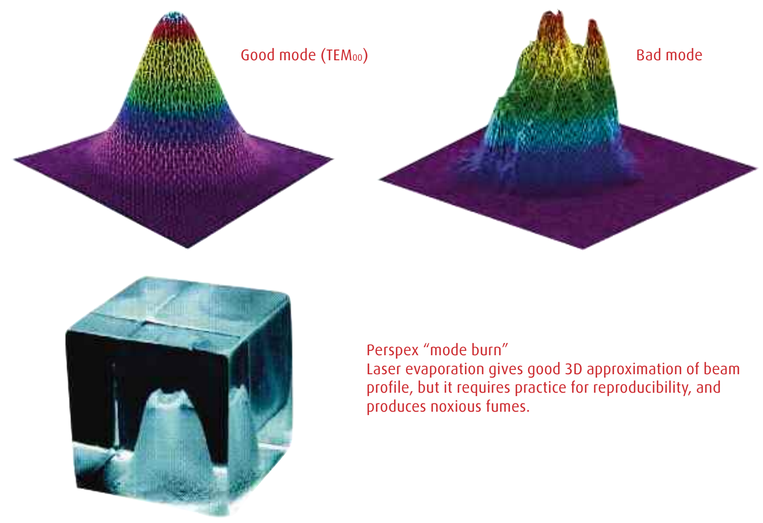
1. Are the mirrors clean?
   → Take power readings after each one

Power losses should be below 5% per mirror

2. Alignment should be square and central
   → Realignment of mirrors requires training

J. Laser mode quality and polarisation

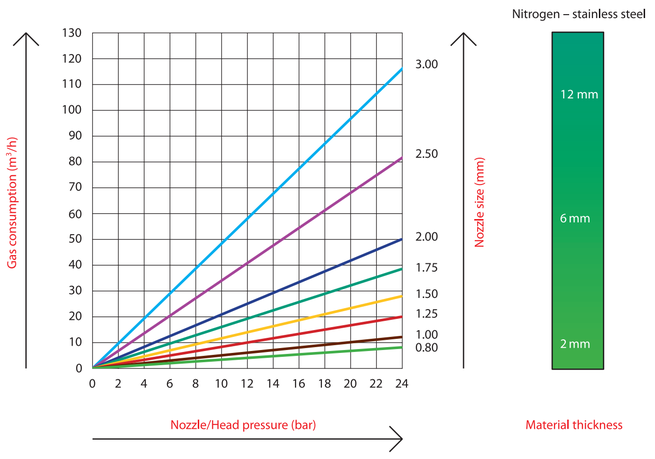
1. The distribution of energy across the laser beam cross section is called its mode
   → Poor mode quality results in poor cutting quality
   → Laser mode identification and tuning require training



Perspex "mode burn"
Laser evaporation gives good 3D approximation of beam profile, but it requires practice for reproducibility, and produces noxious fumes.

2. CO_2 laser beam polarisation requires careful control for successful metal cutting
   → If circular profiles are oval on the bottom but circular on top, the polarising mirror(s) may need cleaning or replacing

Gas consumption vs. nozzle size



Correct conditions

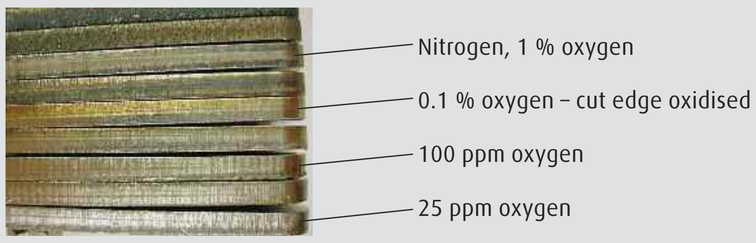
Good cut

This shows a good cut in 8 mm mild steel. Smooth, square cut edge with a light scale of oxide.

Material-related fault

Example of how material quality can affect cut quality – oxygen cutting of low-grade mild steel.

Material-related fault



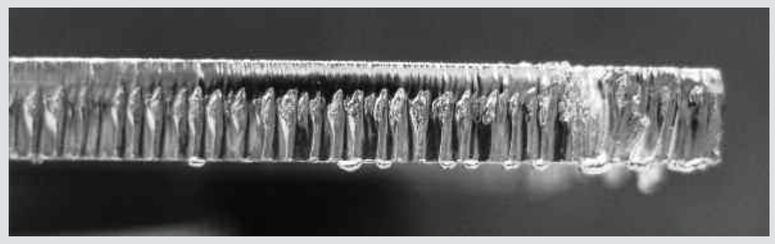
– Oxidation of the cut is evident at 100 ppm purity.
– The edge becomes rough at 0.1 % purity (1000 ppm).

Common faults

Dross

Effect	Problem	Action
Dross (oxygen & nitrogen cutting)	Insufficient melt clearance	Reduce speed
	Processing too fast – evidence of curved drag lines	Reduce speed
	Low pressure – evidence of curved drag lines	Increase gas pressure
	Low power	Increase power
	Poor focus	Check lens
	Nozzle too narrow	Increase nozzle diameter

Slide burning



Effect	Problem	Action
Side burning (oxygen cutting)	Oxygen pressure too high	Reduce gas pressure
	Processing too slowly	Increase speed
	Damaged nozzle	Check/replace nozzle

Cutting unequal in x-y plane

Effect	Problem	Action
Cutting unequal in x-y plane	Polarisation problems	Check and replace
	Damaged phase retarder	Check and replace
	Beam off centre	Align to nozzle

Acknowledgements

Dr John Powell – LIA Guide to Laser Cutting
(Pub: Laser Institute of America)