Thermal deburring
TEM
Thermal energy method
Explosive deburring

Overview of the process, its limitations and effects.
Thermal deburring is a unique process. It utilises the extreme difference in mass between the main bulk of the component and its burrs, and the inability of small parts to dissipate heat quickly. This in the case of burrs, drives their temperature up past their ignition point when they oxidise completely.

The majority of the oxide (gas) is extracted, but some oxide powder (dependant on the mass of burr removed) is deposited on the surface of the component. This can be subsequently removed with a simple wash, either in-house using a 20% phosphoric acid solution for steels or, in the case of aluminium, usually pre anodising.

Thermal deburring is essentially a chemical reaction aided by heat. The heat is generated by combusting natural gas and oxygen under pressure inside a sealed chamber (max size 250 diameter x 330mm high). This blast lasts only 20 milliseconds with temperatures reaching between 2,500 and 3,500°C. The bulk of the heat hitting the surfaces is safely dissipated throughout the component’s mass. Aluminium will typically reach 55-60°C whilst steels reach around 150°C (due to being fired twice). By the very nature of using a gas as the deburring ‘media’, no surfaces are scratched; no hole is too small; no burr inaccessible; and, more importantly, no burr, debris or contaminant missed.

Historically the process was first utilised by the hydraulics and die cast industries. Hydraulics liked the focus on - and guarantee of - removing the smallest, most awkward burrs, and those most likely to come off in service. ‘If it didn’t come off in the explosion it won’t come off in service’ was the thought. The amount of burr removed is influenced by the amount of heat, the material, and the shape of the burr. Milled burrs from using sharp tools tend to produce an even thickness, thin burr. The process will then oxidise them neatly back to the sharp edge of the component. Burrs resulting from blunt tools result in a certain amount of pushed up displaced material before producing the burrs. This shape of burr extends the distance over which the temperature drops. In these cases TEM still oxidises the potential loose parts. It then melts back the next section and, depending on it’s geometry, could possibly leave a raised edge at the root of the burr where the heat safely dissipates into the bulk of the components.

Historical efficiency was the easiest way of ascertaining the best heat setting, the optimum component preparations, and the suitable range of burr variation that will be acceptable and repeatedly deburred.

Although quite sizeable burrs can be removed, by increasing the heat - eventually the process will start to ‘deburr’ the largest burrs. They can then melt and fuse to the body; or even explode and splatter (especially aluminium). For this reason any swarf compacted in holes is best removed. And if sizeable flaps are knocked off with a nylon brush, a better, more even, finished result is obtained. Also oil needs to be removed. Excessive oil can cause pre-ignition of the TEM machines. It also has a tendency to utilise the heat when vapourising, causes a black carbon deposit and subsequently reduces the deburring effect.

The heat could also find the ‘weakest’ part of the component. This is usually the thinnest section, which could start to melt back. Cavities and porosity in castings can be blown open. Threads will normally be left intact (unless they are smaller than the burrs!) as there is a mass of material behind the points. The thin lead-in to the thread, however, will be burnt back along with any whiskers on the threads.

Metallurgical effects are minimal. In most cases, non existent. Negligible dimensional change is usually experienced. Some burr roots could experience hardening to a depth of a few micron, and very thin walled shapes, ie tubes or boxes, could distort with the heat and blast. Fixturing eliminates any bounce damage. Heat sinks can also be used to protect delicate features.
The following are typical examples of before and after burr removal.

Steel cartridges, with a myriad of small burrs and contaminants left after drilling cross holes. 4x mag

Cast iron; the thin leading edge of threads are burnt back and angel hairs removed. 1x

Steel, a typical crown burr and cap left after drilling. 2x

Aluminium manifold; removing the last piece of material pushed away from milling cutter. 3x
Aluminium manifold block; cross hole into thread, time consuming by hand. 3x

Stainless steel; fine milled burrs, easily missed by hand and eye especially with 0.1mm burrs. 10x

Stainless steel; 2mm drilled hole. notice exaggerated effect of surface milling. 40x