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Hand tools for Ex zones

The Institute of Measurement and Control Explosive Atmospheres Special Interest Group (Ex-SIG) aims to promote good practice and support continuing professional development in the Ex discipline through a range of activities and publications. The group produces briefing notes to help inform members on key topics. This article is one such briefing note on hand tools for Ex zones.

(Ex-SIG Briefing Notes are first released to members of the SIG before being made publicly available.)

This briefing note does not give definitive guidance on when/where to use non-sparking tools. It identifies considerations that may bear on that decision, but it remains for the duty holder to come to a judgement on what is appropriate policy given the particular circumstances (materials employed, nature of the work environment, nature of work undertaken) arising in the context of their operation.

It might be thought prudently conservative to require 'non-sparking'* tools in hazardous areas, but this might prove to be impractical, and a rule that is routinely broken may undermine the wider safety culture of an operation. Maintaining the necessary discipline as artificers move from area to area, and job to job, would likely prove difficult. In practice, artificers may simply employ the tool most immediately to hand. Requiring the use of spark-resistant tools as a default may be impractical since they do not offer the same performance in use as steel tools and there is the additional difficulty of maintaining the tools themselves since they are liable to degrade through use (they are more susceptible to wear and may suffer the embedding of grit or tramp metal in the tool surfaces that might compromise 'non-sparking' performance).

**More correctly 'spark-resistant' since these tools do not completely eliminate spark potential. BS EN 60079-36 identifies non-sparking metals as 'e.g. copper (Cu), zinc (Zn), tin, (Sn), lead (Pb), some brasses (CuZn) and bronze (CuSn), which are non-ferrous metals of high heat conductivity and are difficult to oxidise.' Tools marketed as 'non-sparking' are typically available in Beryllium-Copper and Aluminium-Bronze alloys.*

Hazard potential would arise with high energy impacts such as arising from deliberately striking with a chisel and/or hammer, or from inadvertent striking from a dropped heavy tool. Although consideration of these hazards typically centres on maintenance activity, there may well be tools used by operators e.g., wheel keys, that might be of concern.

The hazards arising from light alloys, (aluminium, magnesium, titanium, zirconium) are well known and the introduction of such materials to zoned areas is typically limited and controlled (friction or impact between oxidised (rusty) steel and light alloys give rise to a possible exothermic thermite reaction which can be a source of ignition at relatively low force levels).

Without the possible contribution of a thermite reaction, for steel impacts, it seems impact energy with levels of tens of joules, or that impact velocities in excess of 10 m/s are required as a minimum for any ignition risk to arise – sometimes orders of magnitude more depending on the characteristics of the materials and the atmosphere. An uninterrupted free fall of 5m would be needed for a tool to reach this speed. A 200 g tool would have to have an uninterrupted fall of 5 m to have 10 J of energy. Hand tools such as screwdrivers and sockets or smaller spanners used by instrument maintenance artificers would typically not have sufficient energy or velocity from a fall to exceed these values. Falls would typically be to the immediate floor or platform level and typically much less than 5m.

Although the focus is naturally on the tools, many equipment items have removable covers made of aluminium that may also be dropped. Although the covers are usually protected to a degree by a coating or painting, the threads are uncoated.

Consider also what the tools are used for; if removing bolting or clamps and the like, these become possible drop hazards themselves. There are also drop hazards from scaffolding erection and dismantling where falls may well be from a greater height, since the scaffolding may well extend beyond the usual access platform extent.

In practice the more significant hazard from dropped tools and material, where there is the potential to fall through a greater distance, may be the direct injury of personnel for which suitable precautions should be made anyway.

The informative annex A to EN1127-1:2019 proposes that tools be classified as:

a) tools which can only cause single sparks when they are used (e.g. screw-drivers, spanners, impact screw-drivers)

b) tools which generate a shower of sparks when used during sawing or grinding.

It further proposes that only 'type a)' steel tools should be used in zones 1/21 or 2/22 and then only in zone 1 if the gas classification is NOT IIC, '… unless no hazardous explosive atmosphere is present at the workplace during the work with these tools.'

This then would allow the use of 'type a)' tools without a hot work permit in a zone 1 having classification IIA or IIB, or any zone 2.

Note that the exact mechanism by which mechanical impact ignition might arise is uncertain and a definite relationship with the usual minimum ignition energy or auto-ignition temperature specifications is not identified. A mechanical spark is associated with incandescent particulate material, an electrical spark with electrical energy discharge through ionised gas. The temperatures required to cause ignition are much higher than the usual auto-ignition temperatures, since the localised temperature rise 'hot spot' from an impact will be of only milli or micro-second duration and a mechanical spark will be physically small and travelling through an atmosphere at relatively high speed (unlike a fixed surface).

The informative restriction on zones with classification IIC may be questionable given that the ignition potential may relate to 'hot spot' surface temperatures (rather than spark energy).

Note also that ISO 80079-36:2016 specifies a single impact energy threshold (below which no ignition assessment is required) of 10 J for explosion protection level (EPL) Gb (corresponding with zone 1 use), for sub-division IIC, (and 20 J for a dust EPL of Da), which is more than is typically expected from a dropped tool as discussed above. This standard also gives a threshold for impact velocity of 15 m/s, below which no ignition assessment is required (it is interesting to note that the gas thresholds are given as a function of gas sub-division, which relates to minimum ignition energy, rather than temperature classification).

These figures are NOT applicable if combinations of light alloy-steel, hard steel-hard steel, hard steel-granite arise, or if atmospheres formed from gases such as carbon disulfide, carbon monoxide and ethylene oxide may be present. Special arrangements might well be appropriate if these circumstances are anticipated.

The common understanding of 'hot-work' is of grinding, welding etc. rather than the use of light hand tools, and the conditional extension to light unpowered tools might be difficult to implement consistently, particularly on a site with differing zone classifications.

Given these considerations, and the wider risk arising from dropped material other than hand tools, it may be thought acceptable to use 'type a)' steel tools in all zone 1/21, 2/22 areas regardless of the gas classification, unless some exceptional circumstances should prevail, such as the possible presence of the excluded gases or material combinations identified above.

If an EPL of Ga is identified for a IIC sub-division (typically associated with zone 0) the ignition assessment thresholds fall to 5 J for hydrogen and 3 J for hydrocarbons including acetylene. These thresholds are revised to 60 J for non-sparking metals, and the use of non-sparking tools may well be appropriate. But note that tools made of aluminium-bronze or copper-beryllium alloys should not be used where they may come into contact with acetylene and react to form potentially explosive acetylides. ■

About the author

Harvey T. Dearden CEng is a consulting engineer with HTS Engineering Group Ltd. and registered with the InstMC as both a Registered Explosive Atmospheres Engineer (RExE) and a Registered Functional Safety Engineer (RFSE).