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Tank production for the fabrication of fire extinguishers

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Container production for fire extinguisher manufacturing

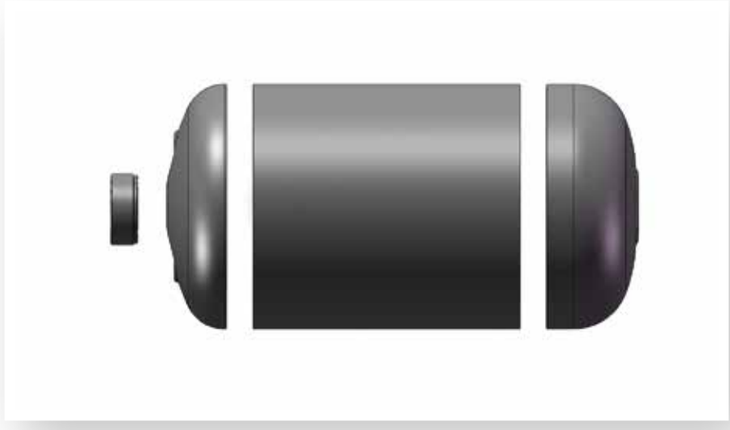
Clean, elegant and inexpensive container production for fire extinguisher manufacturing

Clean, elegant and inexpensive container production for fire extinguisher manufacturing

As a container, the fire extinguisher itself doesn't look particularly spectacular, at first: a base body made of an evenly formed tube, as well as a top and base. In addition, there is a threaded socket for filling and emptying the fire extinguisher, as well as two brackets to fasten it to the wall.

But just as in so many other areas, the devil's in the details:

The three different welded seams require three different approaches. Typically, these are handled in subsequent process steps at different stations of the manufacturing process. The fire extinguisher manufacturer must ensure that the welded seam is sealed sufficiently to stand up to the permanent pressure within the container. This permanent pressure creates an increased safety risk; because of this, pressurised extinguishers are subject to the Pressure Equipment Directive and must pass relevant tests and undergo regular maintenance.



These statutory regulations place high requirements on welded seams. At the same time, the number of fire protection products sold is increasing continuously, and manufacturers of fire extinguishers must product high quantities to satisfy demand.

Customers who buy fire extinguishers expect maintenance-free, inexpensive products, while manufacturers of fire extinguishers want containers with perfect welded seams, in addition to reduced costs.

Classic manufacturing processes used to make fire extinguishers use GMAW welding.

Manufacturing starts with sheet metal from a coil or cut panel which is shaped into a tube and welded using a longitudinal seam with butt joint. Known problems such as initial fusion problems and end craters can occur.

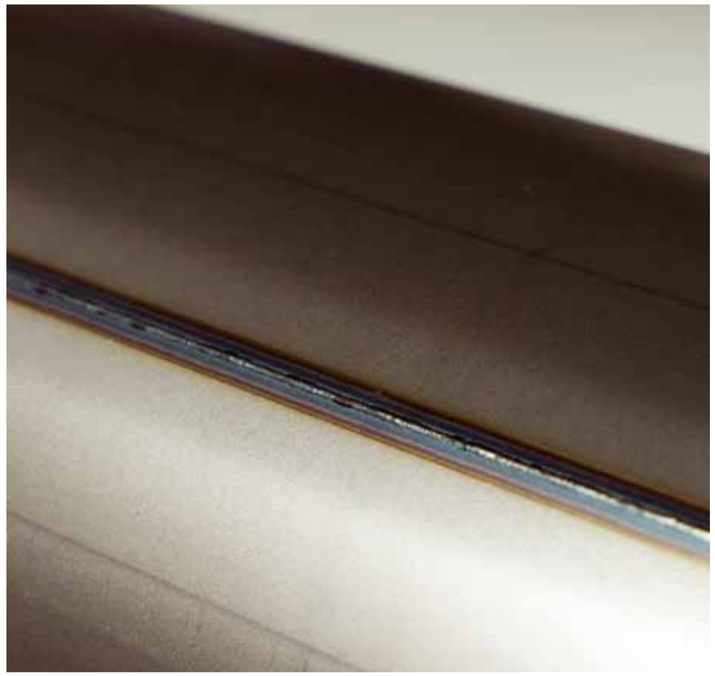
In GMAW welding, we assume a welding speed of 1.2m/min, although for the reasons indicated above only a speed of 1 m/min is usually achieved under real conditions.

One problem with GMAW welding are the weld splatters created, which can require manual reworking and make the process more expensive. Viewed from the outside, the GMAW welded seam has a thick, less than elegant weld bead.

Longitudinal weld seam

Laser welding

In laser welding (LASER = Light Amplification by Stimulated Emission of Radiation), energy in the form of light is highly concentrated and focused on a small point. Bundling the energy onto a very small surface creates a "keyhole" in the direction of the beam, a cavity filled with metal vapour extending to the depth of the workpiece.



The liquid material created collects behind the keyhole, comes together, and forms the welded seam.

The energy of the laser beam, typically 2 to 4 kW, is so high that an energy density of multiple 106 W/cm2 is created at the focal point, which is just approx. 0.3 mm in size. This creates deep and elegant, lean welded seams with a very narrow heat-affected area.

In comparison to the overall sheet, the zone influenced by heat is so narrow that there is almost no thermal distortion.

The welded seams created, however, offer only limited gap bridgeability.

Today, this is no longer really a problem in LASER welding, since suppliers of cut panels can produce cut edges suitable for LASER processing without any additional cost.

Laser welding is an excellent choice for butt welds, which are welded quickly at a welding speed of 5-7 m/min with panel thicknesses of 1.2 to 2.0 mm typical for fire extinguishers.

Welding the threaded ring

The lid of the fire extinguisher container / body must be fitted with a socket in an upstream manufacturing process before the container is completed. There is a threaded ring in the lid of the fire extinguisher which is used to fill or empty it.

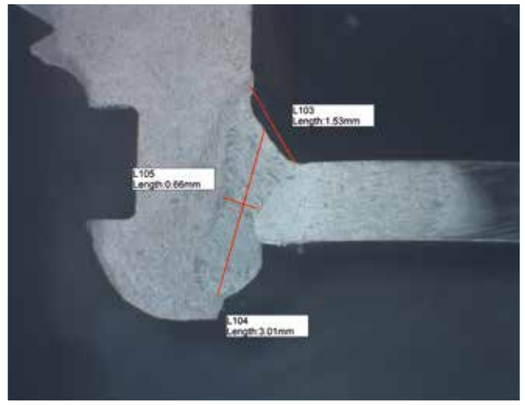
Typically, the threaded ring is inserted through the punched hole in the lid using a clearance fit. This manufacturing process is a separate work step.

The challenge in inserting the threaded ring is that this connecting piece must also withstand the same pressure inside the container. In GMAW welding, additional material is applied from the outside. A high level of heat input always poses a danger of thermal distortion. As a result, the thread can become warped and require reworking. In addition, there is also always the danger of weld splatter, which also requires reworking.

In LASER welding, the deep welded seam creates a full connection that provides a high level of pressure resistance. Because only individual points are heated, the thread retains its dimensional stability and no reworking is required.

This also brings up another advantage of LASER technology: The laser beam from a beam source can both weld the longitudinal seam on the tube and be deflected to another station via a beam switch. This means the auxiliary process time during loading and unloading the panels can be used to weld the threaded ring to the lid.

In addition, the increased welding speed offered by LASER welding allows operators to coordinate cycle times for the individual process steps so as to create an optimal process flow. This higher degree of automation, in turn, reduces manufacturing costs.



Joining lid and base

The lid, base and tube are joined during the next work step. The lid and base of a fire extinguisher are trimmed deep-drawn parts, which are joined with the longitudinally welded pipe to the base body of the fire extinguisher. The better the individual parts fit together, or the more tolerant the welding process is, the less susceptible the overall process is to defects.
In most cases, the connection between deep-drawn part and pipe has a gap just a few tenths of a millimetre in size. Conventionally, the connection between the base, lid and pipe is created using a lap joint and GMAW welding. This process stands out for its good gap bridgeability.

Container production for fire extinguisher manufacturing

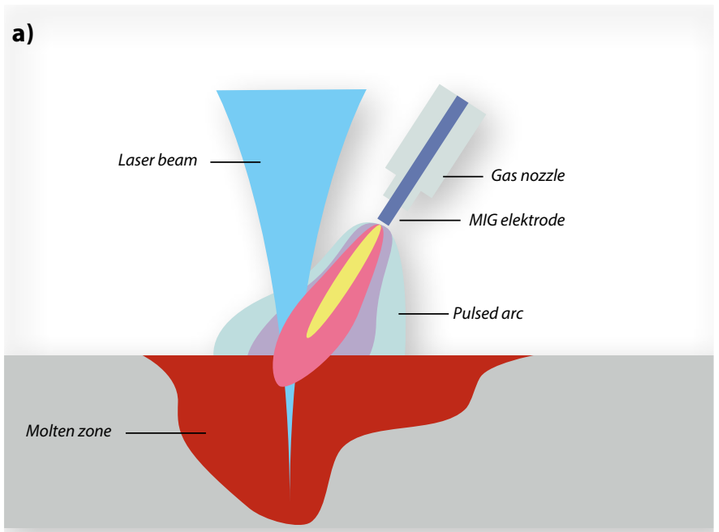
Compensating for production tolerances and ensuring the seam's seal results in additional material. The additional material increases production costs, and the open connections inside the fire extinguisher are susceptible to corrosion. In another downstream work step, therefore, the containers are coated to provide corrosion protection and fill in the protruding edges of the backing.

Working with an additional material during GMAW welding always poses the danger of bonding errors. These, in turn, can result in up to 6% reworking on the finished container.

As an alternative to this process, a butt weld can be used to join the lid or base to the pipe; it saves material in contrast to an overlapping seam. The manufacturing process or panel cut can result in a slight longitudinal offset on the pipe (Fig. 2). To bridge this offset, a LASER hybrid process (Fig. 3) is used when welding on the lid and base. This involves a combination of laser and GMAW welding: A combination of a trusted process and an innovative technique. Following the laser optic, the keyhole is filled with the additional material from the GMAW process. This allows the operator to bridge gaps of 0.4 - 0.6 mm.

The LASER hybrid process combines the advantages of the two technologies by combining the high welding speeds of LASER welding with

the gap bridging capabilities of GMAW welding. This process can achieve welding speeds of up to 3.5 m/min. In contrast to the welded bead created in common GMAW welding, evidence of high wire material usage, the LASER hybrid process uses only around 20-30% of the typical amount of wire, creating an elegant, slim welded seam. In addition, this type of welding does not create any corrosive edges, and the thickness of the coating can be reduced significantly as backing is not required. In addition, saving coating material also reduces manufacturing costs for the fire extinguisher. LASER hybrid welding does not create bonding errors in the weld seam, however process-based errors may occur. The frequency of such errors is less than <1 %.



a) Laser MAG hybrid welding combines the large penetration depth and high welding speed of laser welding with the high melting power and broad weld pool of MAG welding. As a result, even components with relatively large tolerances can be joined with process certainty and at a high speed. b) Typical arrangement of laser beam and MAG torch in laser MAG hybrid welding. c) Grind of a laser MAG hybrid welded seam.

Manufacturing process as an overall concept

Conventional fire extinguisher construction combines different individual stations with different cycle times. Apart from the production area required for the three times more GMAW welders required to achieve the same output as in LASER welding, MAG welding requires personnel in many areas to keep the manufacturing process running.

In these days of skilled labour shortages, however, manually operated stations are a constant source of fault-prone logistics and can significantly reduce output.

A fully-automated manufacturing process in a compact machine system is an optimal use of production space and cycle times: The combination of LASER technology and proven GMAW technology makes it possible to produce three times as many containers in the same amount of time and with less space and personnel, while also reducing material usage and rework and maintaining the same good quality.

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