

## Innovative Solid Block Design: Changeover to X-Mas Tree with Integrated Ball Valves

Within the scope of overhauling several X-Mas trees for gas production, a completely new design of construction was decided on: In the place of X-Mas trees with gate valves, solid block X-Mas trees with integrated ball valves have already been in operation at several North German locations since 2018.

This concept unites the preferences for a compact design with the advantages of gas-tight ball valves over gate valves – at high and in particular also low pressures. Also decisive was the positive experiences with safety ball valves as complementing quick-closing valves in the above-ground installations. The in-

novative design, which was developed in close collaboration between Hartmann Valves and the operator, provides not only for increased safety and simple operability but also for significantly reduced maintenance requirements.

### The Wellhead as Central Component

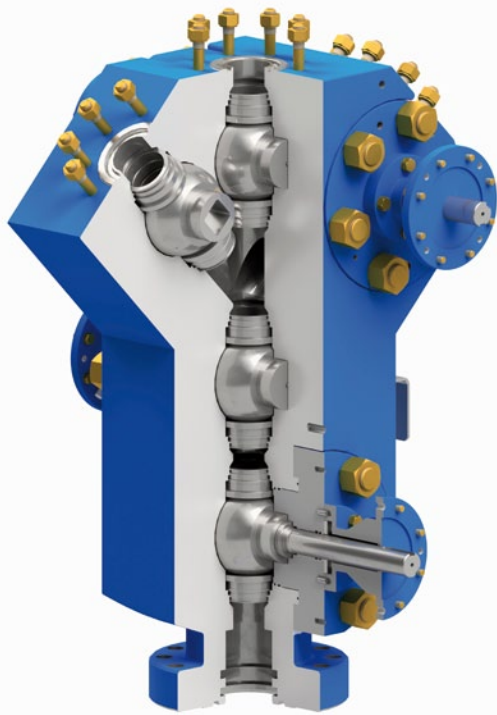
The wellhead constitutes the interface between the underground borehole and the above-ground plant. Therefore in terms of its design (material selection, nominal bore, pressure rating etc.) both the geological conditions and the process engineering requirements of the plant must be taken into consideration. Besides increased safety requirements for personnel and the environment, such aspects as a compact design for minimising the visual appearance can also be significant in terms of increased public acceptance. Moreover, a certain durability is demanded for wellhead equipment, which can amount to 20 to 30 years. In the extraction of gas or oil a multitude of particles and concomitant materials are entrained in the medium flow. This places high demands on all plant components, in particular on the valves which ought to exhibit a particular resistance and long service life. In the light of minimising the assembly time and costs, a rapid and uncomplicated installation of the wellhead becomes increasingly significant.

### Quick-Closing Ball Valves as Complementing Safety Valves

In the area of gas production the X-Mas tree, as an above-ground component, is traditionally implemented as a compact solid block design. Also in numerous North German plants, X-Mas trees with integrated gate valves as shut-off valves were used as standard for decades but which were stretched to their limits in some areas or were complemented by



Fig. 1 Successful changeover: The X-Mas tree with ball valves and quick-acting shut-off valve is almost maintenance-free while used in gas production



**Fig. 2** The integration of ball valves instead of gate valves ensures an increased safety, a maintenance-free and simplified operation

special ball valves. In order to increase plant safety, quick-closing safety valves were augmented which can shut off the production flow within the shortest time. The valves should also enable a slow pressure increase at plant start-up. To accommodate these requirements Hartmann Valves developed a special ball valve 4 1/16" API 10,000 (690 bar) with a special actuator. This shut-off concept has been successfully deployed in gas production by several operators for approx. 15–20 years, even with a high sour-gas fraction. The pure metallic sealing system with hard coated ball resists the extremely short closing times and higher flow velocities which occur during the pressure equalisation when the valve is opened. The fail safe close actuator has the necessary spring force to close the ball valve within a few seconds. The associated control system enables progressive opening in predetermined angles.

**The Advantages of Ball Valves**

Due to the positive experience with these high performance valves and the decade-long deployment of ball valves in operators' further oil and gas plants, ball valves have been selected in principle – also as components in future wellheads. That's because it's precisely in this combination that robust ball valves demonstrate more advantages in terms of safety and reduced maintenance requirements: Hartmann ball valves with pure metallic sealing bet-

ween ball and seat ring fulfil a leak rate of A in all pressure ratings. That means they are absolutely gas-tight – not only at high pressures but also even at low pressures, such as occur in older, nearly depleted wells. The previously deployed gate valves are in this respect stretched to their limits in terms of leak-tightness and closing times due to their design. This leak-tightness results from the spring-loaded seat rings whereby the spring force is equivalent to 20–30 bar. Ball valves moreover offer a higher level of safety than gate valves as they have less tendency to block because the ball only rotates within its own volume. Whereas a gate valve can block when dirt gets into the housing and deposits develop.

One reason for the significantly lower maintenance requirements is that regular "lubrication", i.e. replenishing with grease to seal and fill the

housing, is not necessary. Hence neither can grease get into the media flow, downstream plant components, the borehole or the formation. In downstream plant components this can lead to the contamination of filters, for example, or to the formation of emulsions. If grease gets into the borehole, this can even have a negative influence of the productivity of the well. Ball valves are moreover subject to significantly less wear at the actuating shafts or stems. Due to the 90° (1/4) turn instead of 30 to 40 turns (or even linear movement) the wear is correspondingly reduced. The maintenance requirements saved on, lead to significantly reduced costs of upkeep over the entire service life. From experience, operators talk of "10 years maintenance free operation" with Hartmann ball valves.

Decisive for the robustness and long service life is an appropriate material selection as well as surface treatments and special coatings – against corrosion, for example.

Besides the safety and maintenance aspects, ball valves integrated into wellheads are also distinguished by simple, clear and thus, above all, safe operation: The position (open or closed) is very simply read by the diamond marks on the gearbox. While in the case of an X-Mas tree equipped with gate valves all the operating elements are orientated to the front, with an X-Mas tree equipped with ball valves the upper master valve and the top valve are operated from the

rear and bring the personnel, for example during wire line workovers, out of the safety endangered area below the cable.

**Innovative Design: X-Mas Tree with Ball Valves**

In recent decades, Hartmann wellheads with gas-tight ball valves have therefore proven themselves as a very successful and reliable combination in the field of oil and gas storage as well as deep geothermal energy – in each case tailored to the customer's specific requirements. A block design, by which a total of five ball valves are integrated into a solid block, had hitherto not been on the market. In this case these are 4 1/16" ball valves API 10,000 (690 bar) in the material class CC and temperature class P/U. With this compact integral design, the functions of several valves and wellhead components are brought together in a single module. Due to the saving of flange connections, the dimension and the weight are reduced and the overall safety is increased because the single barrier flange connections are extinguished. Added to that, the installation time is reduced, corrosion-prone nuts and bolts are dispensed with and an absolutely perpendicular installation with uninterrupted drift diameter is a given.

The installation was carried out by the qualified Hartmann service team which is also available for regular inspections in support of the integrity management.

**Operational Experience and Outlook**

The first ball valve X-Mas trees in new solid block design have been operating since 2018. Especially with view of the required integrity and low maintenance concepts, a convincing and worthwhile design is now available. Deployment in sour gas plants is likewise possible: Hartmann Valves already has wide-ranging experience with the high level of safety requirements due to the potential hazard presented by hydrogen sulphide contained in the sour gas – from material usage to non-destructive testing to comprehensive documentation. The trusting cooperation and the direct work and communication through to the company management is what has persisted for decades and what the operators particularly value in the supplier relationship. Besides the geographical proximity, the flexibility as well as availability and willingness to help with optimisations or completely new approaches are decisive. The joint project work takes place with those responsible for design, sales and service and the possibility exists to take a look into the production at any time.

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