DISCUSSION

T. V. Miller[1]

I wish to commend the author for his excellent presentation of pressure-energized flange design criteria.

This paper covers work by the author which is a definite contribution to the Petroleum Industry and to other industries which have use for flanged type of connections. The adoption of the described flange design as a standard by the API Division of Production for use in high-pressure drilling and production flanges is proof of its acceptance. This type of flange design, which will enable manufacture of connections with working pressures in excess of those currently available is particularly important at this time. The continuation of deep exploratory drilling and resultant discovery of abnormal pressure hydrocarbon reservoirs will no doubt require the use of this type of flange in the near future. The pressure-energized principle will permit flanges to be of reasonable dimensions for working pressures in excess of 15,000 psi.

Speaking for my company, we have used with success a considerable number of this type flange in 10,000 and 15,000-psi working pressure service. We have also adopted as standard the use of the API "RX" pressure-energized type of ring gasket in the regular API flanges of our drilling rig blowout preventer assemblies. The "RX" gasket, in addition to offering a better sealing connection, has saved as much as 24 hr of rig time required for assembling and obtaining leakproof blowout preventer connections.

I wish to thank you for the opportunity of commenting on this excellent paper.

J. A. Mottram[2]

The author is to be congratulated for his continued pursuit of a subject of great importance to the high-pressure field and for the very clear-cut concise manner of his presentation. There is today a very definite need of a basis for the design of gaskets and flanges for pressures beyond the present scope of ASA and MSS Standards. This is particularly true of the chemical process industry where pressures up to 25,000 psi must be dealt with.

The author points out the savings possible by use of the pressure-energized type of gasket configuration as opposed to the conventional bolt-seated gaskets. We at Taylor Forge have designed gaskets based upon this principle, using the methods outlined in this paper, for flanges as large as 30 in. ID, and at pressures up to 6000 psi. Not only have these gaskets proved equally successful in operation; they have surpassed the performance records of the other high pressure gasket configurations by a very great percentage.

We wish to point out, however, that while the author's basis for the flange design stress of one half the yield point is justified in the petroleum casing field, when the designer is dealing with chemical process flanges, this concept must be approached carefully. We at Taylor Forge are not prepared at this time to say just what the stress level of these flanges should be, but we urge the designer to recognize this need for caution.

We would also like to point out that in addition to the flange loads and stresses shown on the calculation sheet, thought must be given in these high pressures to stresses induced by other loadings. The designer must consider the effect of external bending, axial loading of the hub due to internal pressure, and the effect of flange rotation upon the longitudinal bending stress in the hub.

We congratulate the author for his very practical approach to the design of high-pressure gaskets and flanges.

G. E. Nevill[3]

The author has made a distinct contribution to flange design literature by this record of design criteria and appropriate explanation. In connection with his activities in API and the Association of Wellhead Equipment Manufacturers, the author has probably done more of the flange design work under this criteria than any other person.

We have had several instances where similar information on other subjects was available only from the memories of the participants in the design and standardization activities, and we are particularly pleased over the publication of this paper.

In Section II, Design of Flanges With Pressure-Energized Gaskets, the author says "Under bolt-up, zero pressure condition, the bolt load is carried by the faces, therefore the gasket width is independent of the bolt load, and the land between groove and bore can be somewhat narrower than in the code design, since it does not carry any load."

The final $^{3}/_{64}$ in. pull-down coins the gasket between the groove faces and apparently does produce a force tending to widen the groove and thus load the land between the groove and bore. I wonder if the author would comment on this.

In our experience with underwater operations we have observed that the overturning forces which produce bending in flanged joints of wellhead assemblies can be of a very high order. This might occur if the drilling vessel drags its anchors or is blown out of position.

The present flange, since it is tightened against the raised faces and not on a gasket, should possess a greater degree of rigidity and be more resistant to overturning forces.

The author's comments on this point would be welcome.

We commend the author for this addition to the permanent literature on flange design.

Author's Closure

The author wishes to thank the discussers for their thorough perusal of the paper and the resulting comments.

Mr. Mattram's comment on stress levels is fully justified. In paragraph II(b) of this paper, the author has recommended the use of code stresses for uses other than atmospheric temperature service in the oil industry.

Mr. Nevill's comment on the width of land between bore and ring groove also is correct. In the final seating of the gasket, a load is created against the inner flank of the groove. Apparently, the width of land is sufficient, since no trouble at this point has ever been reported in hundreds of applications in the oil fields.

Concerning overturning forces, this question needs to be investigated. It may be desirable to design special flanges with greater diameter face contacts for underwater applications.

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[1] Humble Oil & Refining Company, Houston, Texas. Mem. ASME.

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