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FLOW TESTS OF ENLARGED OUTLET
FITTINGS-BDF REACTORS

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To: J. M. Batch

From: E. D. Waters *EDW*

FLOW TESTS OF ENLARGED OUTLET FITTINGS-BDF REACTORS

Ref: HW-73447 - "Flow Testing of Enlarged Rear Face Hardware
B, D, F, DR Reactors," letter to J. M. Batch from
D. H. Frieling, P. H. Hutton, April 20, 1962.

Flow tests which were requested in the referenced letter have been completed and the results of these tests are reported herein. Figure 1 presents data which allow the determination of the normal operating flow rates for process tubes equipped with the various combinations of fittings tested. Figures 2 and 3 show the losses through these fittings, both with and without vaporization allowed, and also show the relative contribution of the different fittings to the total pressure drop across the outlet assembly.

Flow tests were conducted with four different combinations of outlet fittings, as described in Table I. Using typical reactor conditions of fuel loading and front and rear header pressures, as given on Figure 1, the normal operating flow rate was determined on Figure 1 for these four assemblies and was tabulated in Table I. It was found that changing the header fitting and nozzle outlet fitting size while retaining the 5/8 inch OD pigtail (assembly B) results in about 5 per cent increase in operating flow rate over the present standard assembly. Assemblies C and D with the 3/4 inch OD pigtail both result in about 8 per cent increase in the operating flow rate. The nozzle outlet fitting of assembly C was shaped like a venturi, rather than being a straight bore adapter. Since the pressure is high enough to prevent vaporization at this location with the slight constriction, there is only a

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slight difference in the pressure drop of assemblies C and D. (The static pressure change due to the reduced flow area is only about 13 psi at 50 gpm. The pressure drop through the pigtail is over 18 psi at this flow rate. Hence, the pressure at the pigtail outlet will always be less than the pressure at the throat of this nozzle outlet fitting and vaporization will occur first at the outlet end of the pigtail.)

TABLE I

Outlet Assembly	Hdr. Parker Fitting ID*	Pigtail		Nozzle Outlet Fitting ID*	Operating Flow Rate Figure 1 gpm**	% Change **	Comments
		OD	ID*				
A (Standard)	0.469	5/8	0.545	0.469	48.20	0.0	
B	0.548	5/8	0.545	0.550	50.65	5.1	
C	0.608	3/4	0.625	0.547	52.05	8.0	
D	0.608	3/4	0.625	0.628 O	52.15	8.2	

* Actual measurements - inches. A standard BDF rear nozzle with 0.625 horizontal water channel was used. Both pig-tails were of a helical design similar to the original DuPont type.

** These numbers are obtained under the assumption that the front header pressure is maintained at 580 psig.

The pressure drops are presented in Figure 2 for these four assemblies using a high back pressure to assure no vaporization. By comparing the pressure drop from EOAS to RH, as shown on Figures 1 and 2, one finds that vaporization is occurring in assembly A under normal operating conditions but not in assemblies B, C, and D. In doing this, the data of Figure 2 should be reduced in pressure drop by about 5 per cent to allow for correction to normal outlet temperatures. Thus, the data of Figures 1 and 2 can be used to determine the rear header pressure which would allow incipient critical flow as discussed in HW-52302.

The effect of vaporization on pressure drop is also shown on Figure 3 by comparing the ΔP from EOAS to RH for two different rear header pressures. Rear header pressures from 10 to 40 psig do not affect the EOAS pressure for assembly A and thus would not affect the normal operating flow rate. However, with assemblies B, C, and D, the rear header pressures from 10 to 40 psig or more do affect the EOAS pressure and would affect the normal

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operating flow rate for these assemblies. For example, if the rear header pressure were increased from 40 psig to 70 psig, the per cent flow change for assembly D would only be ~5 per cent rather than the 8.2 per cent because this pressure change would decrease the operating flow for assembly D but not for assembly A.

The flow rate increases which would result from use of assemblies C or D are not quite as large as one might first expect by referring to data of HW-63756-1. However, this can be explained by the following facts: (1) The rear header pressure used in the present Figure 1 is higher than that used in the previous report. This does affect the operating point of assemblies B, C, or D as discussed previously. (2) The 3/4 inch pigtail of the present report is of the helical design which has a higher ΔP than that of the J-type pigtail.

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Figure 1

Figure 2

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See Inset for pressure tap location.
Outlet Water Temp. = 110 C
Flow Rate = 50 gpm (metered cold)

Figure 3

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