NEW ZEALAND AGRICULTURAL
ENGINEERING INSTITUTE

THE FLOW CHARACTERISTICS OF SOME PRESSURE REDUCING VALVES

PROJECT REPORT P/11

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OCTOBER

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CONTENTS

1. INTRODUCTION

Pressure reducing valves are commonly used in farm water supply and trickle irrigation installations. Although they have been used for a long time there is little detailed information on their flow characteristics. This report gives some technical information to assist in designing systems using pressure reducing valves.

All the valves tested were originally designed for domestic use.

Further tests may be carried out as other valves become available or as necessary.

2. DESCRIPTION OF THE PRESSURE REDUCING VALVE

A pressure reducing valve is used in a water supply pipeline to control the pressure on the downstream side of the valve. Should the pressure downstream of the valve approach a certain preset maximum value (called the sealing pressure) the valve will reduce or shut off the flow in the pipeline. The effect is to maintain the pressure downstream of the valve less than or equal to the sealing pressure.

The sealing pressure is set by the manufacturer but can be readjusted over a range of pressures depending upon the design of the valve.

All of the valves tested incorporate a rubber diaphragm and spring to control the water pressure. (See Figure 1)

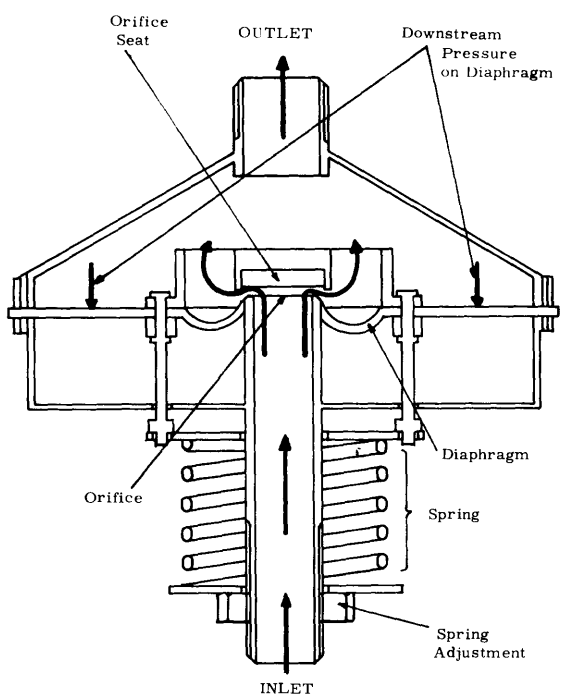


Figure 1. The pressure reducing valve

The outlet pressure acts on the rubber diaphragm. The higher the outlet water pressure, the greater the pressure transmitted from the diaphragm to the orifice and seat which control the flow. The spring balances the pressure from the diaphragm on the orifice and seat. The higher the preload in the spring, the higher the downstream pressure required to shut off the flow.

3. SUMMARY OF THE VALVES TESTED

Manufacturer	Model	Sealing Pressure (metres head)
AJAX	Fulflo	7.61
NEFA	Supaflo	3.66
NEFA	Supaflo	7.61
NEFA	Supaflo	12.2
VICTOR	Delrin	3.66
VICTOR	Hi-Range	3.66
VICTOR	Delrin	7.61
VICTOR	Hi-Range	12.2

4. TESTING PROCEDURE

The testing apparatus is shown in Figure 2.

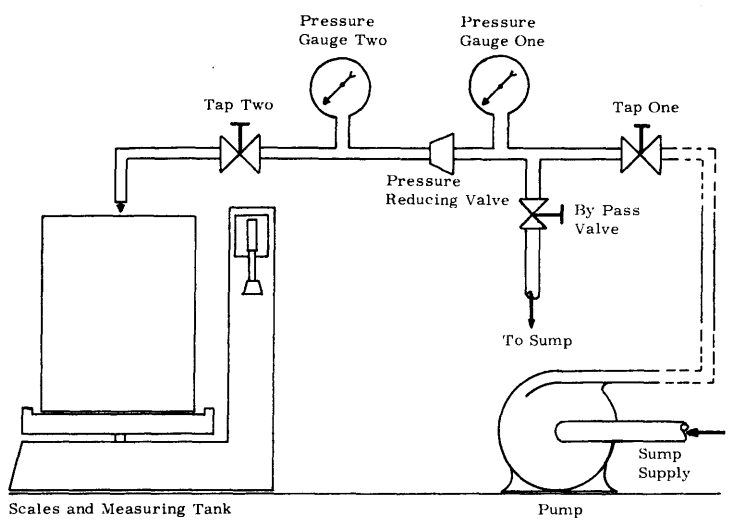


Figure 2. The testing apparatus

4.1 DEFINITIONS OF THE VARIABLES STUDIED

Inlet Pressure - (Pi) : Pressure in the pipeline on the high pressure side of the valve

Outlet Pressure - (Po) : Pressure in the pipeline on the reduced pressure side of the valve

Sealing Pressure - (Ps) : Outlet pressure at which the valve will automatically shut off the flow i.e. the maximum outlet pressure

4.2 SEALING PRESSURE: CHECKING AND ADJUSTMENT

The sealing pressure, as preset by the manufacturer, was checked at an inlet pressure of 70 m head. If necessary, it was adjusted to the value stated on the valve. This was done by: (refer Figure 1)

(i) Closing tap two and adjusting tap one to obtain an inlet pressure of 70 m head. In general, the sealing pressure varied slightly with different inlet pressures. The inlet pressure of 70 m head was taken as a normal inlet pressure likely to be met in practice.

(ii) Tap two was opened to release the outlet pressure and then closed again to obtain a sealing pressure corresponding to 70 m head inlet pressure.

(iii) The spring compressor in the valve was adjusted so that the reading given by pressure gauge two (Po) corresponded to the desired sealing pressure.

(iv) Tap two was opened and closed several times to check the accuracy of the setting.

4.3 TESTING UNDER VARIOUS FLOW AND PRESSURE CONDITIONS

When in use the valve is likely to operate under relatively constant inlet pressure and it is the outlet head that is being continually varied.

For this reason the inlet pressure was held constant by the use of tap one and the by-pass valve whilst the outlet head was varied by adjusting tap two. The flow rate for each pressure setting was measured by weighing the amount of water that passed through the valve in a specific time.

The inlet pressure was varied over the range 0 - 70 m head whilst the outlet pressure was varied over the range 0 - 10 m head.

5. RESULTS

5.1 PRESENTATION

From the data obtained a graph of the outlet pressure versus rate of flow for different inlet pressures was drawn. From this curve the Flow Charts were constructed. These are graphs of outlet pressure versus inlet pressure for varying flow rates.

5.2 ACCURACY OF THE CURVES

To see if similar valves had similar flow characteristics, an

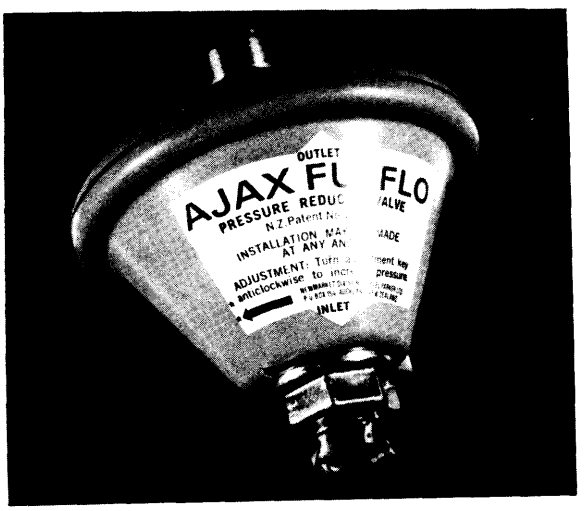
additional test was made on some other valves. Two valves were tested for each of the following models:

Make	Model	Sealing Pressure
Victor	Hi-Range	12.2 m head
Ajax	Fulflo	7.61 m head
Nefa	Supaflo	7.61 m head

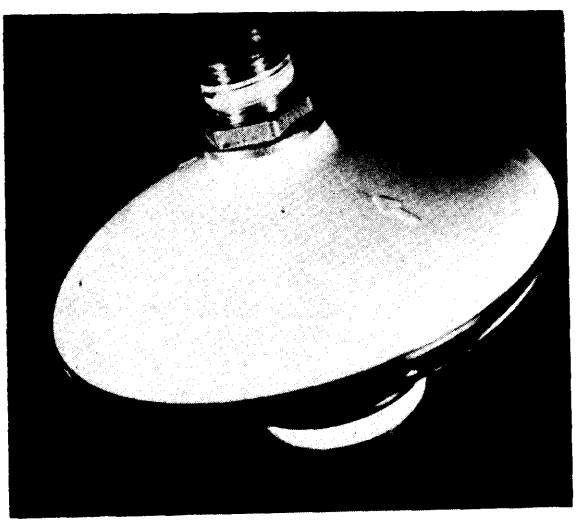
A Victor Hi-Range with a 3.66 m head sealing pressure was adjusted to obtain the Victor Hi-Range with a 12.2 m head sealing pressure. Similarly, a Nefa Supaflo with a 3.66 m head sealing pressure was adjusted to obtain a Nefa Supaflo with a 7.61 m head sealing pressure.

Data referring to the adjusted valves is marked ADJ 3.66 - 12.2 m head and ADJ 3.66 - 7.61 m head.

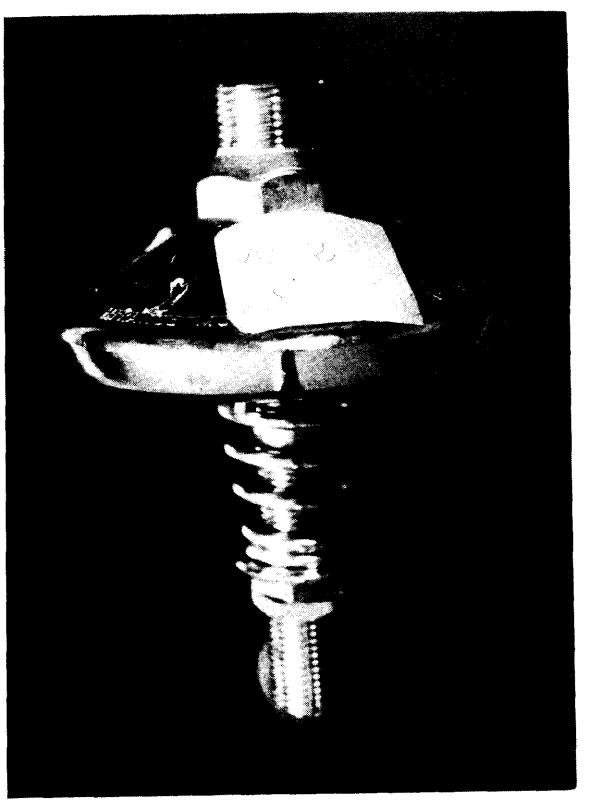
No further tests were made because duplicates of the other valves were either not available at the time of testing or could not be simulated by adjusting the valves on hand.



Ajax Fulflo



Victor Delrin



Victor Hi-range

Figure 3. Types of pressure reducing valves

5.3 AJAX FULFLO 7.61 m HEAD SEALING PRESSURE

General

The valve is available with special sealing pressure settings on request. Only the 7.61 m head was tested.

It is fitted with a non-return device to stop backflow.

Construction

The casing is moulded plastic with a brass core through the valve. The diaphragm is sealed to the brass conduit by means of an O-ring operating on the nylon jumper.

Sealing Pressure

The sealing pressure adjusting screw allows a 3 m head range in sealing pressure.

Manufacturer

Samuel Parker Ltd, Auckland.

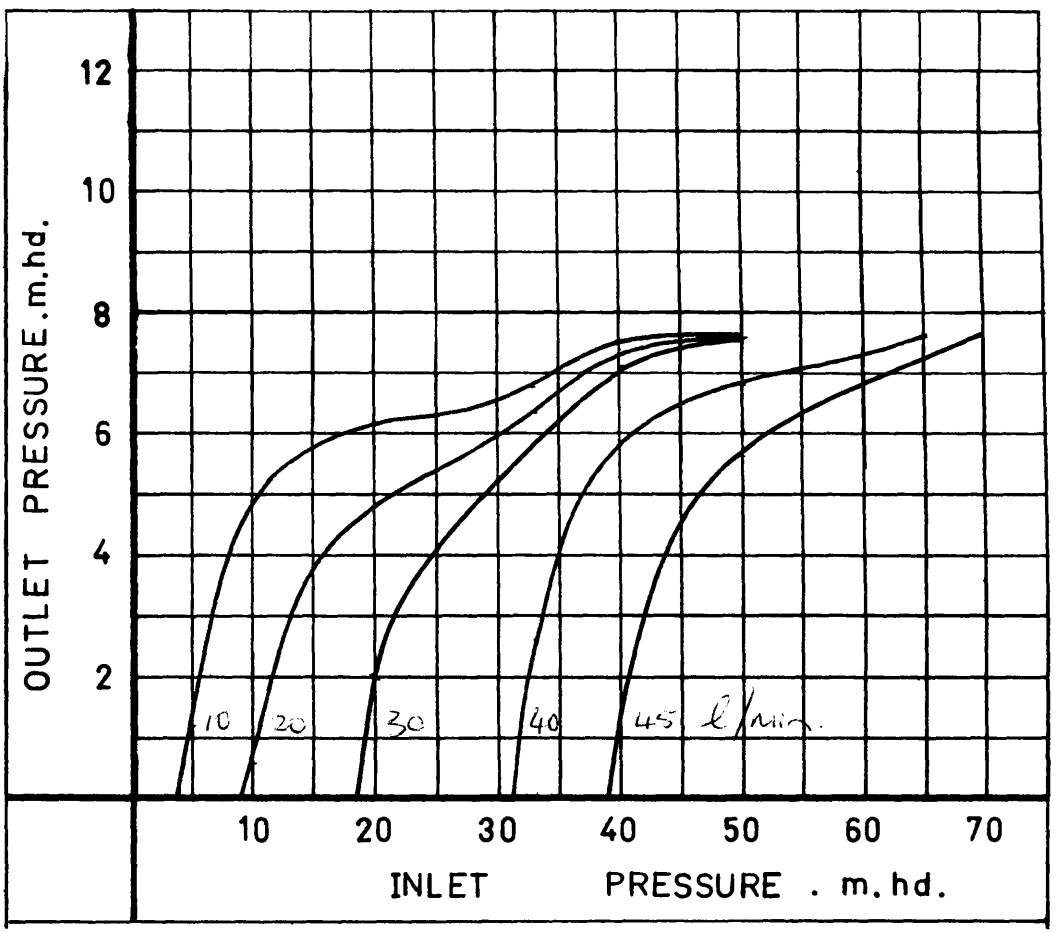


Figure 4. Ajax Fulflo. Sealing pressure 7.61 m/hd.

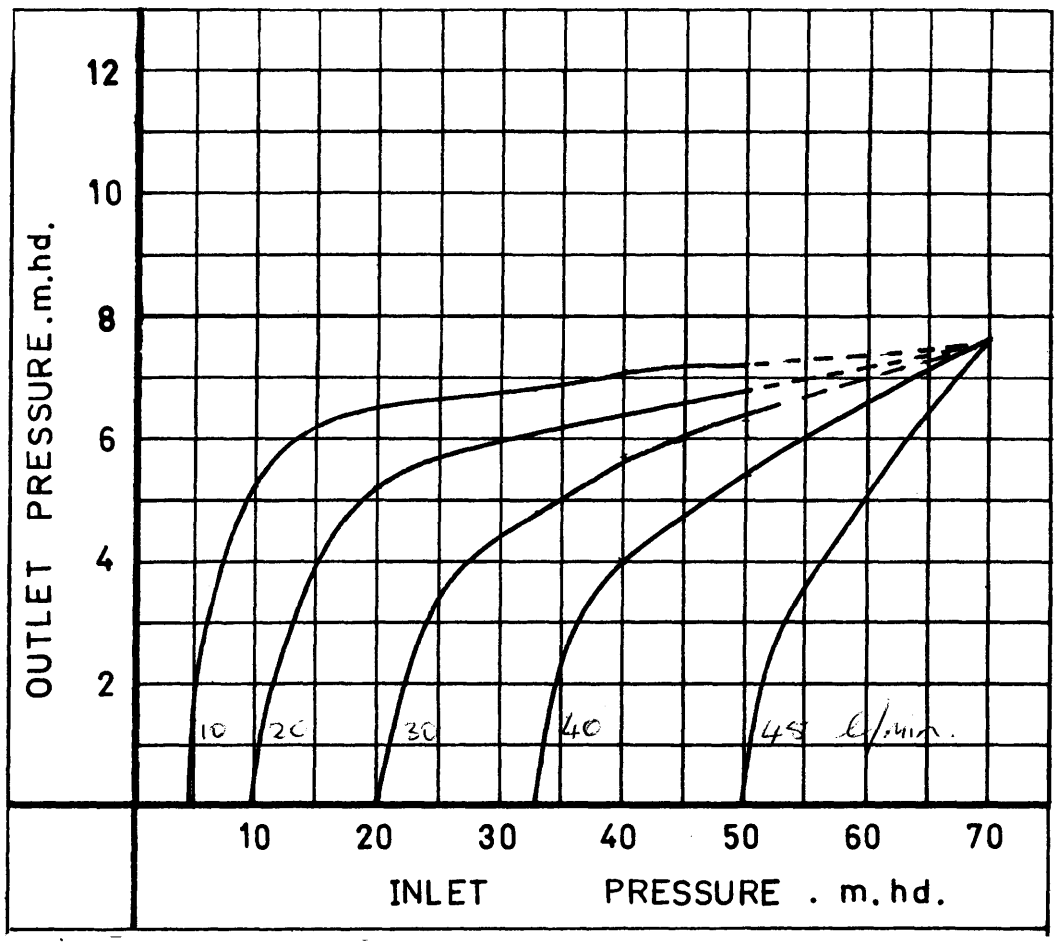


Figure 5. Ajax Fulflo. Sealing pressure 7.61 m/hd.

5.4 NEFA SUPAFLO 12.2, 7.61, 3.66 m HEAD SEALING PRESSURE

General

The 12.2, 7.61 and 3.66 m head sealing pressure models are of identical construction. They are fitted with non-return devices to stop backflow.

Construction

Cast brass

Sealing Pressure

The adjusting screw allows an adjustment of about 5.5 m head variation in sealing pressure.

Manufacturer

Noel Products Ltd, Auckland.

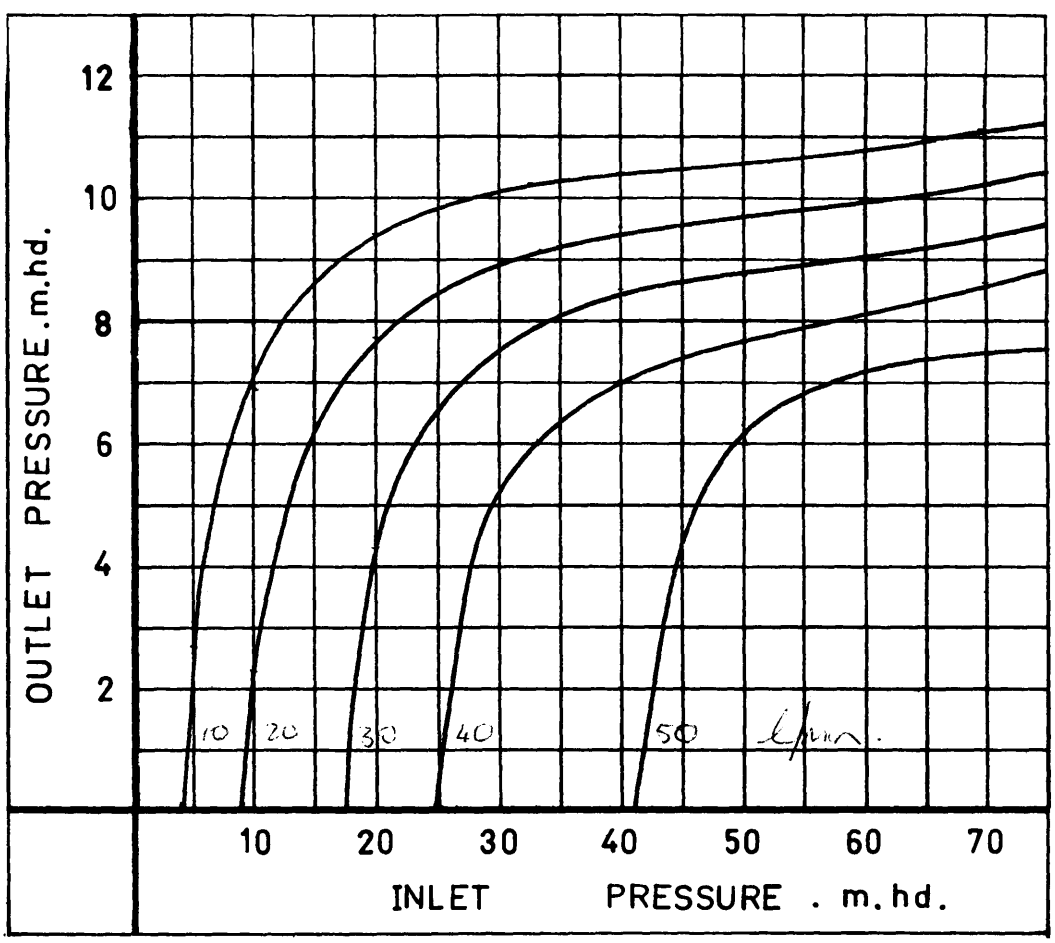


Figure 6. Nefa Supaflo. Sealing pressure 12.2 m/hd.

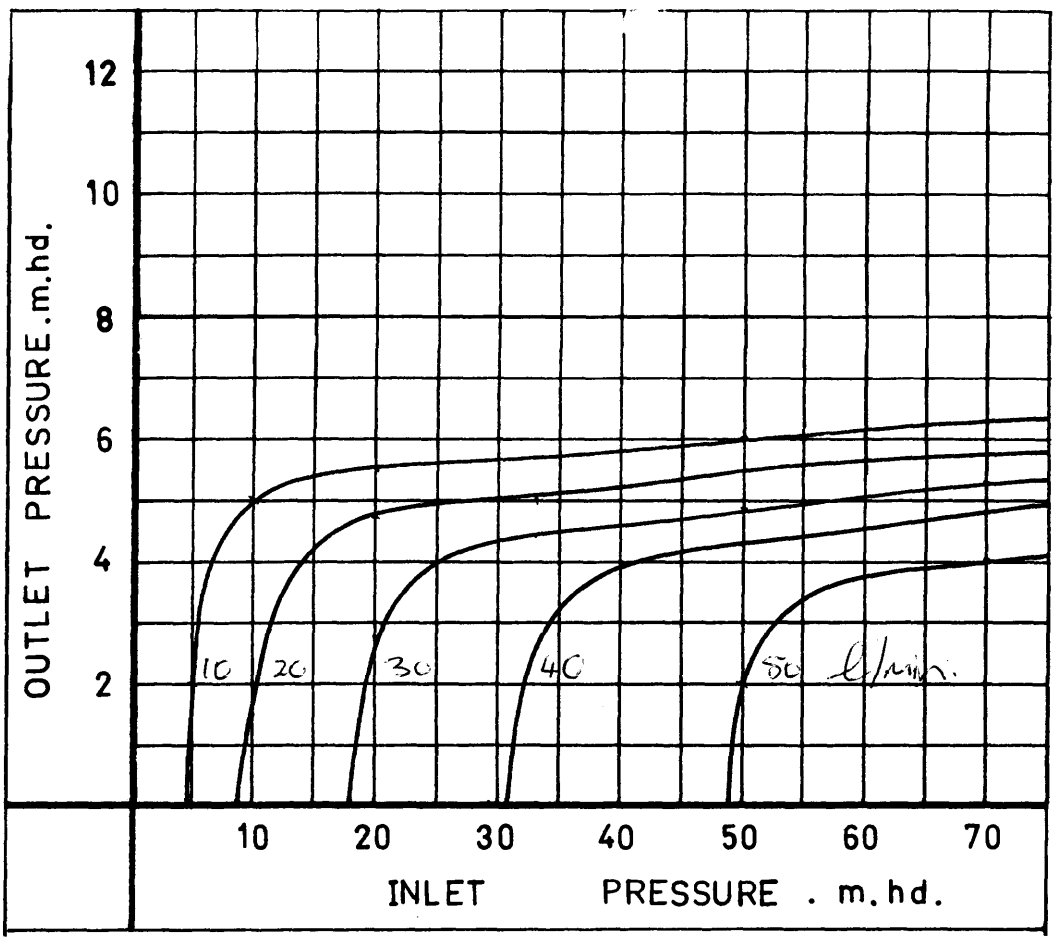


Figure 7. Nefa Supaflo. Sealing pressure 7.61 m/hd.

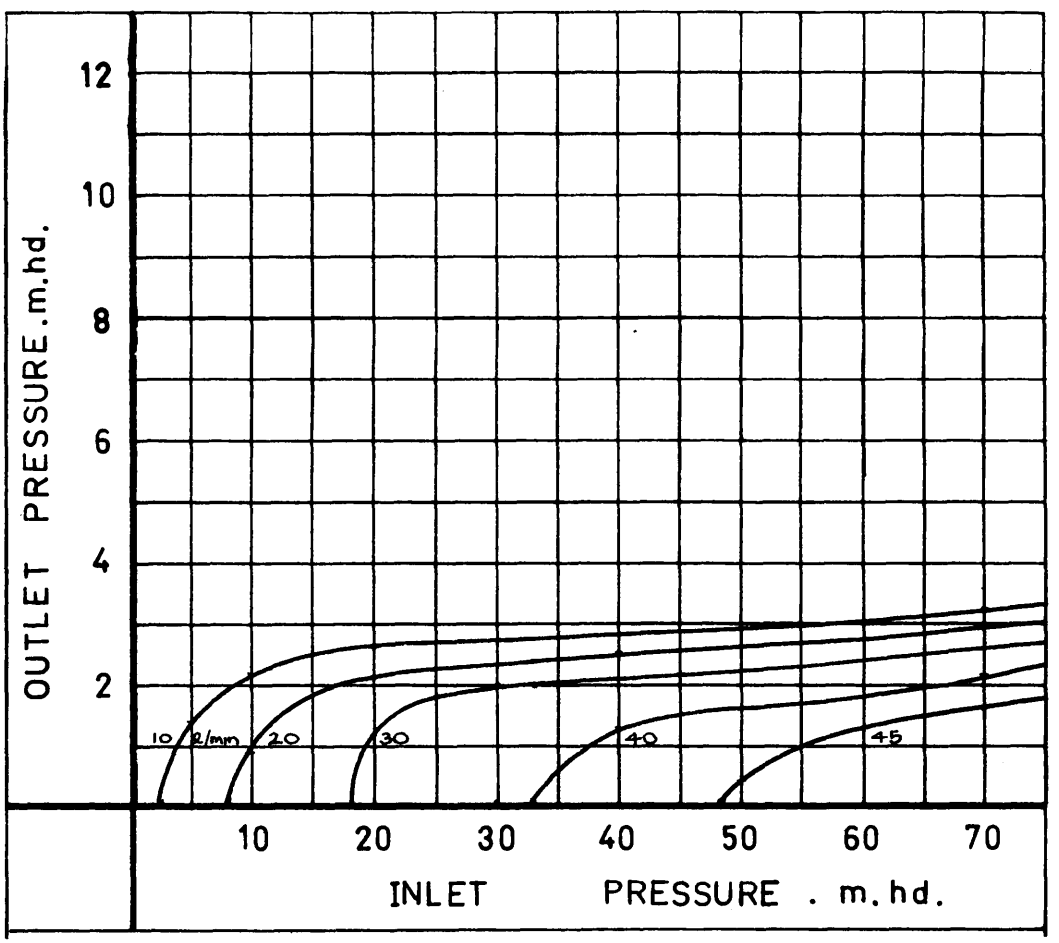


Figure 8. Nefa Supaflo. Sealing pressure 3.66 m/hd.

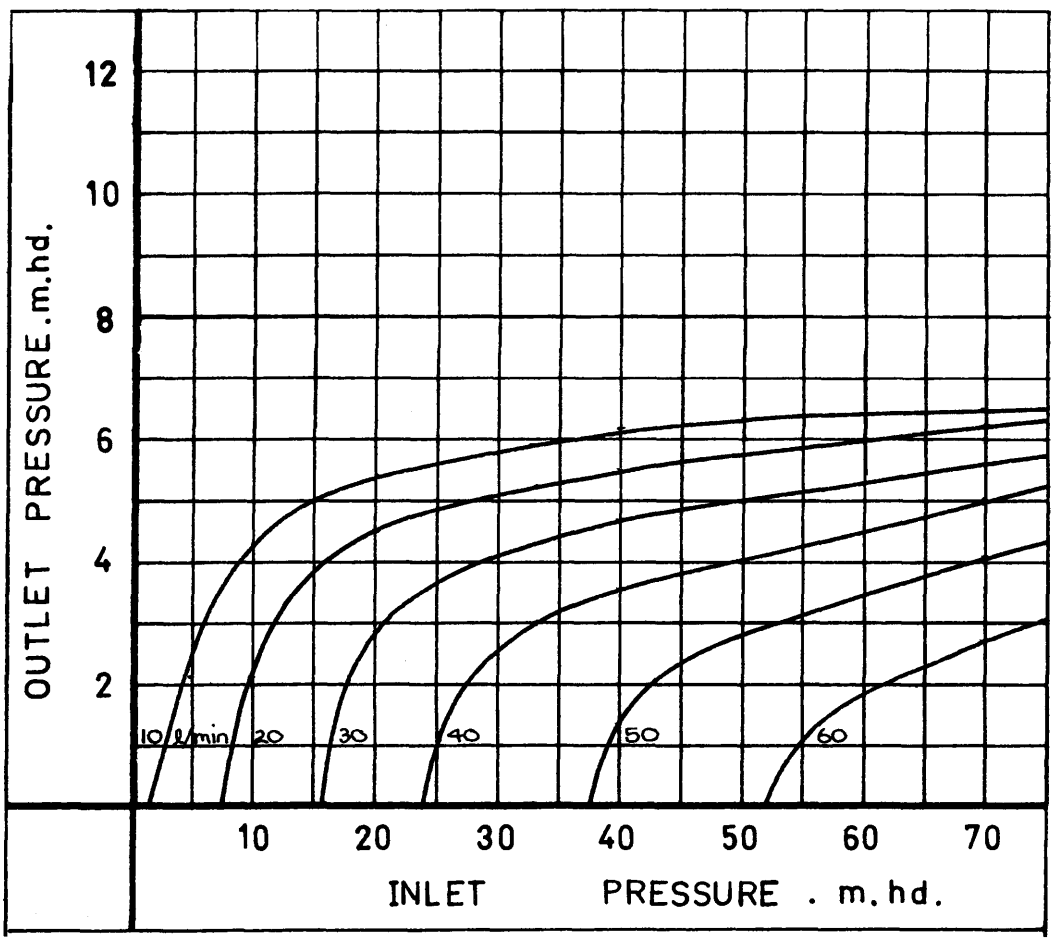


Figure 9. Nefa Supaflo. Sealing pressure 7.61 m/hd. Adjusted 3.66 to 7.61 m/hd.

5.5 VICTOR 'DELRIN' 7.61 and 3.66 m HEAD SEALING PRESSURE

General

The 7.61 m head and 3.66 m head versions are of identical construction.

They are fitted with non-return devices to stop backflow. These may be easily removed to increase the flow rate slightly.

Construction

Moulded plastic casing.

Sealing Pressure

The sealing pressure may be varied about 5.0 m head.

Manufacturer

G. Methven and Co., Dunedin.

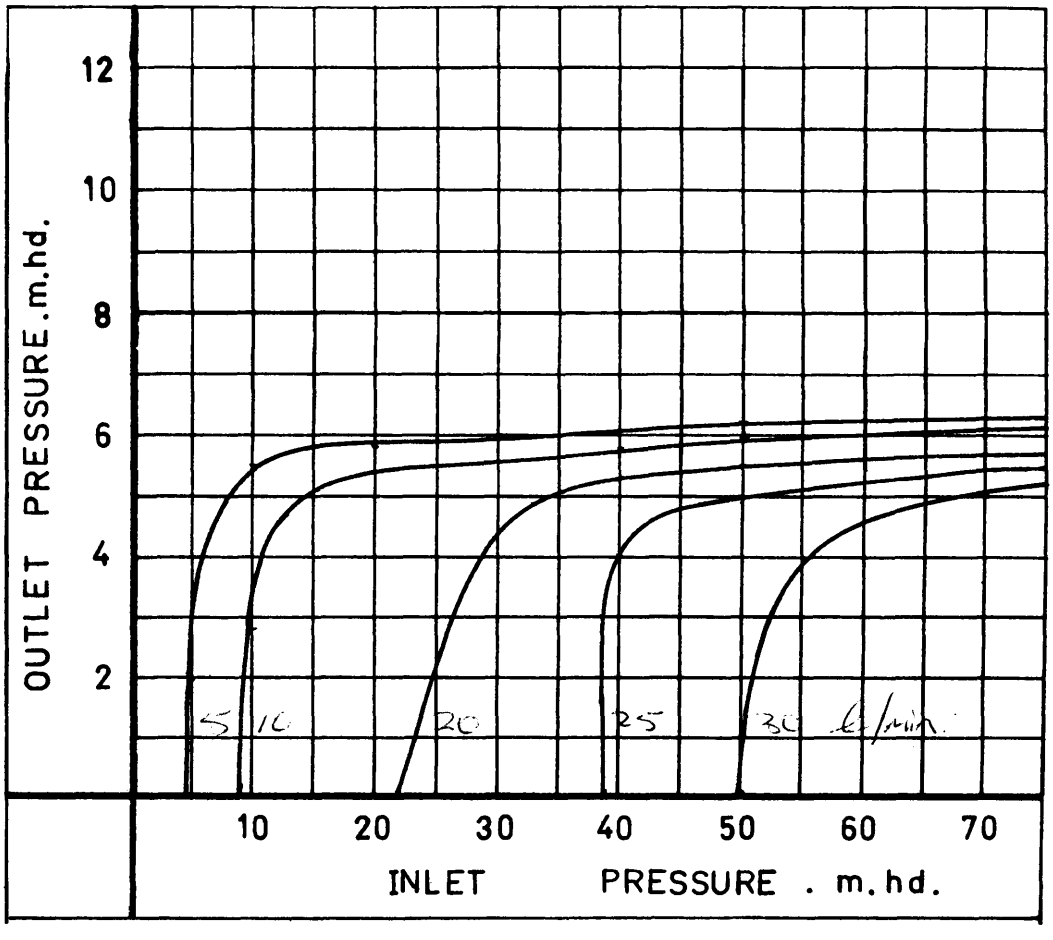


Figure 10. Victor Delrin. Sealing pressure 7.61 m/hd.

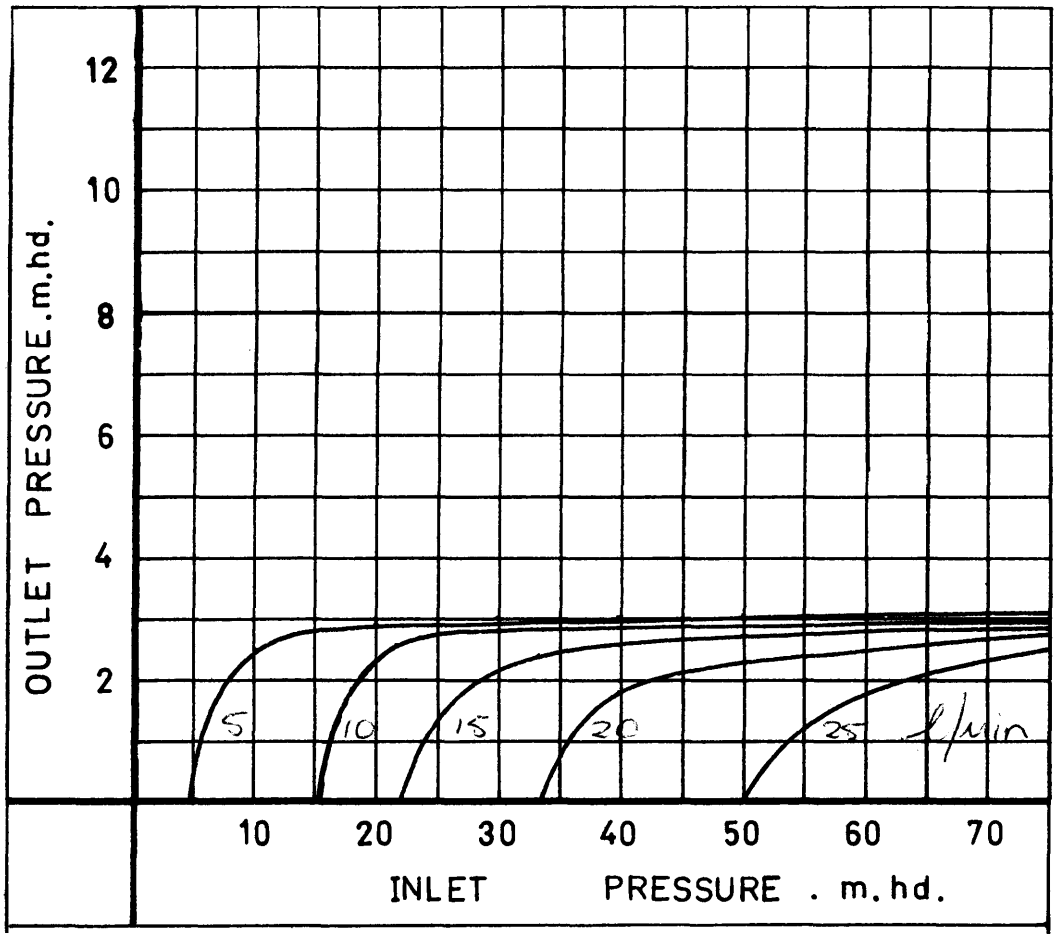


Figure 11. Victor Delrin. Sealing pressure 3.66 m/hd.

5.6 VICTOR HI-RANGE 12.2 and 3.66 m HEAD SEALING PRESSURE

General

The 12.2 and 3.66 m head models are of identical construction, and are fitted with non-return devices which can be removed if desired.

Construction

Cast brass. Chromium plated.

Sealing Pressure

The sealing pressure may be varied by 10 m head.

Manufacturer

G. Methven and Co. Ltd, Dunedin.

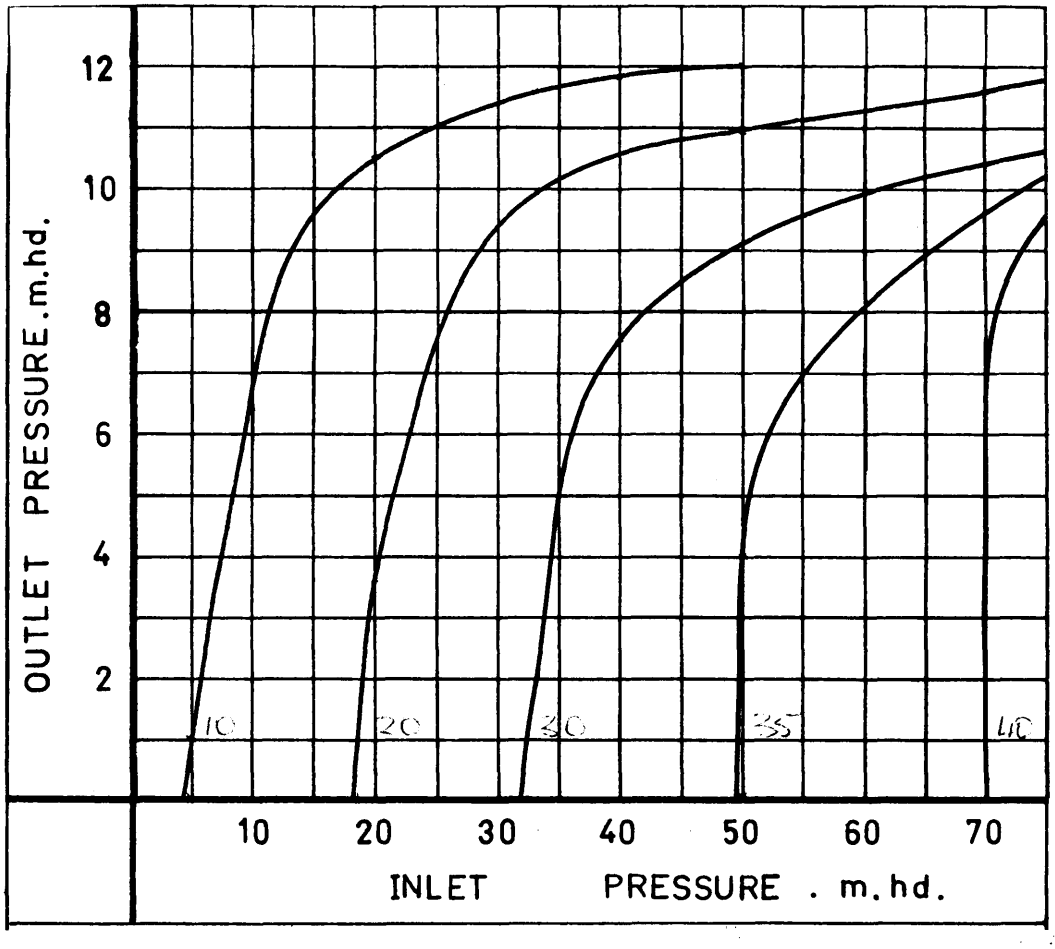


Figure 12. Victor Hi-range. Sealing pressure 12.2 m/hd.

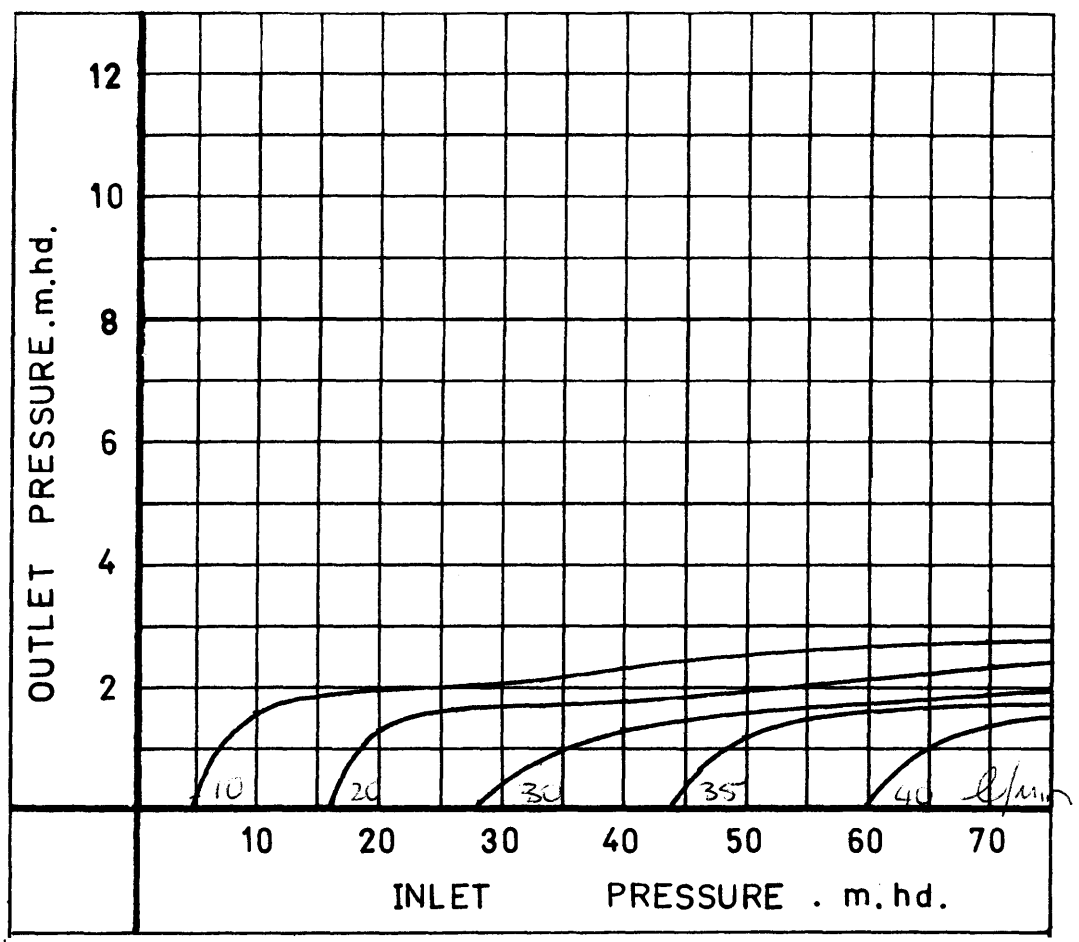


Figure 13. Victor Hi-range. Sealing pressure 3.66 m/hd.

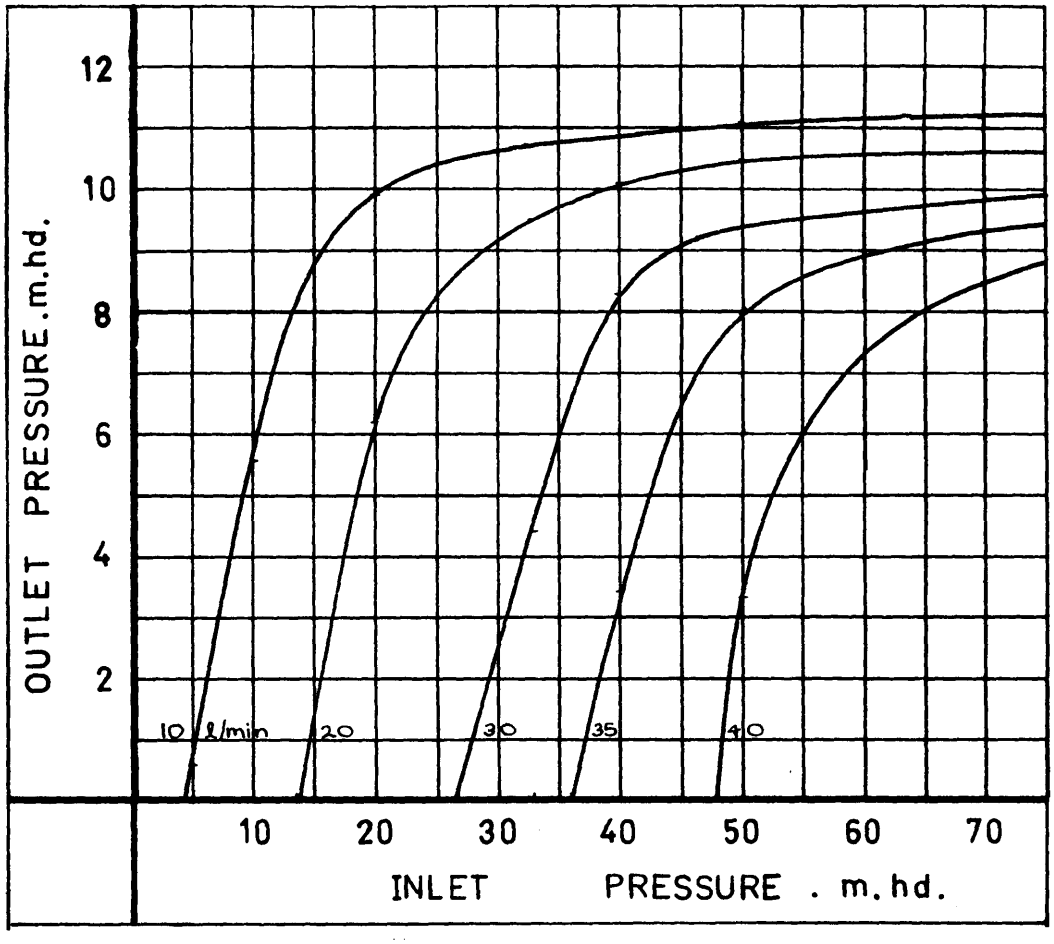


Figure 14. Victor Hi-range. Sealing pressure 12.2 m/hd. Adjusted 3.66 to 12.2 m/hd.

APPENDIX

NOTE ON IMPERIAL TO METRIC CONVERSIONS

1 litre per minute = 0.22 imperial gallons per minute

Metres head	Psi	Foot head	KPa
1	1.42	3.28	9.81
2	2.84	6.56	19.62
3	4.26	9.84	29.43
4	5.68	13.12	39.24
5	7.10	16.40	49.05
6	8.52	19.68	58.86
7	9.94	22.96	68.67
8	11.36	26.24	78.48
9	12.78	29.52	88.29
10	14.19	32.80	98.10
20	28.40	65.60	196.20
30	46.60	98.40	294.30
40	56.80	131.30	392.40
50	71.00	164.00	490.50
70	99.39	229.60	686.70

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