

ENVIRONMENTAL TEST REPORT

For

DK TECH CO., LTD.

ON FOUR (4) SPOOL ASSEMBLIES

GARWOOD LABORATORIES, INC.

- DSCC-VQ Approved
- ISO-9002 Certification
- Accredited by A2LA
(ISO Guide 25)



Tel: 562-949-2727
Fax: 562-949-8757

September 18, 2001

Report No.: R24612-1
Rev.: N/C
Page 1 of 8

Since 1954

ENVIRONMENTAL TEST REPORT

ON
FOUR (4) SPOOL ASSEMBLIES

FOR
DK TECH CO., LTD.

PERFORMED For: DK TECH CO., LTD.
568-17 Kwebup-Dong, Sasang-Gu
Busan, Korea, 617-060

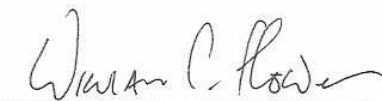
PERFORMED By: GARWOOD LABORATORIES, INC.
7829 Industry Ave.
Pico Rivera, CA 90660

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Prepared By:



R.M. "RICK" CLEMENS, Technical Writer

Approved By:


WILLIAM FLOWER, Quality Assurance Manager



Approved By:


TIM STURKIE, Laboratory Manager



GARWOOD LABORATORIES, INC.
TESTING AND ENGINEERING SERVICES

DSCC-VQ Approved
ISO 9002 Certification
Accredited by A2LA
(ISO Guide 25)
NRTL Recognized

7829 Industry Ave., Pico Rivera, CA 90660

Tel: (562) 949-2727

Fax: (562) 949-8757

JOB NO.: 24612-1

Page No.: A-1

*** GENERAL DATA SHEET ***

Customer: <u>D K TECH CO. LTD</u>	Date: <u>9-14-01</u>
Test Title: <u>HELIUM LEAK TEST</u>	Witness? <u>NONE</u> Photos: <u>709-712 X</u>
Test Item: <u>FITTINGS</u>	Quantity: <u>4</u>
Part/Model No.: _____	Serial No(s): <u>A-D</u>
Per Specification: <u>S.O.W.</u>	Rev.: _____ Method/Para.: _____
TEST DESCRIPTION	
<p>MASS SPECTROMETER WAS SET-UP AND CALIBRATED USING A HELIUM STANDARD LEAK RATE OF 3.1×10^{-8} STANDARD CENTIMETERS/SECOND. 200 INCREMENTS WERE RECORDED (TOTAL DEFLECTION) WHICH IS EQUAL TO 1.55×10^{-10} SCCS HELIUM/INCREMENTS.</p> <p>A TOTAL OF FOUR (4) SPOOLS WERE TESTED INDIVIDUALLY. EACH SPOOL WAS PRE-ASSEMBLED BY CUSTOMER PERSONNEL USING VARIOUS FITTINGS. EACH SPOOL WAS TESTED BY APPLYING 5000 PSIG HELIUM INTERNALLY TO SPOOL UNDER TEST. ANY LEAKS WERE THEN DETECTED WITH A FIXED PROBE CONNECTED TO A MASS SPECTROMETER.</p> <p>RESULTS: OF THE FOUR SPECIMENS TESTED LEAKAGE WAS FOUND TO BE LESS THAN 1.28×10^{-8} SCCS HELIUM.</p>	

TEST EQUIPMENT LIST

Asset No.	Description	Manufacturer	Model No.	Cal Date	Recall Date
0658	MASS SPECTROMETER	C.E.C.	24-120B	P.T.U.	
0600	HELIUM STANDARD	C.E.C.	B-25643	28 AUG. 01	28 AUG. 02
0149	PRESS GAUGE	ASHCROFT	MAXISAFE	31 AUG. 01	31 SEP. 01

Sub-Page: <u>1</u> of <u>1</u>	Test Technician(s): <u>REISA</u> Inspector: <u>1 QA</u>	Test Engineer(s): _____ DCMA: _____
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REPORT NO.: **R24612-1**

Page No.: **2 of 8**

ENVIRONMENTAL TEST REPORT

TABLE OF CONTENTS

<u>PARA.</u>	<u>PAGE</u>
TITLE PAGE.....	1
TABLE OF CONTENTS.....	2
DISCLAIMER.....	3
1.0 PURPOSE.....	4 – 5
2.0 REFERENCES.....	5
3.0 SUMMARY.....	6
4.0 TEST CONDITIONS AND EQUIPMENT.....	7
5.0 TEST SEQUENCE.....	8
6.0 TEST METHODS AND RESULTS.....	8 – B1
6.1 Helium Leak.....	8
Appendix A: Lab Data Sheets, Logs, Plots, etc.....	A1
Appendix B: Photograph(s).....	B1



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REPORT NO.: **R24612-1**

Page No.: **3 of 8**

ENVIRONMENTAL TEST REPORT

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Fax: (562)949-8757**GARWOOD LABORATORIES, INC.**REPORT NO.: **R24612-1**Page No.: **4 of 8****ENVIRONMENTAL TEST REPORT****1.0 PURPOSE**

- 1.1 The purpose of this report is to present the procedures employed and results obtained while conducting the Environmental Test of Helium Leak, on four (4) Spool Assemblies, P/N: Spool A, Spool B, Spool C, and Spool D, with each Spool Assembly listed in Table I, submitted by DK Tech Co., Ltd.

TABLE I

SPOOL ID	DK P/N	DK DESCRIPTION	SWAGELOK ASSEMBLIES
A	DMC 4-4N	Male Connector 1/4" x 1/4" NPT	Nut
	DU-4	Union 1/4"	Front/Back Ferrule, Body
	DL-4	Union Elbow 1/4"	Front/Back Ferrule, Body
	DUR 4-2	Reducing Union	Front/Back Ferrule, Nut
	DL-2	Union Elbow 1/8"	Front/Back Ferrule
	DU-2	Union 1/8"	Front Ferrule, Nut, Body
	DC-2	Cap 1/8"	Back Ferrule
B	DMC 8-8N	Male Connector 1/2" x 1/2" NPT	Front Ferrule
	DU-8	Union 1/2"	Front/Back Ferrule, Nut, Back Ferrule
	DL-8	Union Elbow 1/2"	Front Ferrule, Nut, Nut
	DUR 8-6	Reducing Union 1/2" x 3/8"	Front/Back Ferrule
	DL-6	Union Elbow 3/8"	Front/Back Ferrule, Nut
	DL-6	Union Elbow 3/8"	Front Ferrule, Nut
	DU-6	Union 3/8"	Front/Back Ferrule, Nut
C	DC-6	Cap 3/8"	Nut
	DMC 16-12N	Male Connector 1" x 3/4" NPT	Front Ferrule
	DU-16	Union 1"	Front/Back Ferrule, Body
	DL-16	Union Elbow 1"	Nut
	DUR 16-12	Reducing Union 1" x 3/4"	Front/Back Ferrule (2)
	DU-12	Union 3/4"	Nut, Body Nut
	DL-12	Union Elbow 3/4"	Front Ferrule, Nut (2)
D	DC-12	Cap 3/4"	Front/Back Ferrule
	DMC 16-12N	Male Connector 1" x 3/4" NPT	N/A
	DU-16	Union 1"	N/A
	DUR 16-12	Reducing Union 1" x 3/4"	N/A
	DTBF 12-12N	Female Branch Tee 3/4" x 3/4" NPT	N/A
	DC-12	Cap 3/4"	N/A
	DCF 8-12N	Female Connector 1/2" x 3/4" NPT	N/A
	DTBF 8-6N	Female Branch Tee 1/2" x 3/8" NPT	N/A



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REPORT NO.: **R24612-1**

Page No.: **5 of 8**

ENVIRONMENTAL TEST REPORT

DMC 6-6N	Male Connector 3/8" x 3/8" NPT	N/A
DUR 6-4	Reducing Union 3/8" x 1/4"	N/A
DUR 4-2	Reducing Union 1/4" x 1/8"	N/A
DL-16	Union Elbow 1/8"	N/A
DUR 4-2	Reducing Union 1/4" x 1/8"	N/A
DL-4	Union Elbow 1/4"	N/A
DU-4	Union 1/4"	N/A
DUR 6-4	Reducing Union 3/8" x 1/4"	N/A
DL-6	Union Elbow 3/8"	N/A
DUR 8-6	Reducing Union 1/2" x 3/8"	N/A
GNR 12-8N	Hex Reducing Nipple	

- 1.2 The Environmental Test specified in this report was performed in accordance with the references listed in Para. 2.0 of this report.

2.0 REFERENCES

- 2.1 PO0108-USA-1 DK Tech Co., Ltd., Purchase Order
- 2.2 S.O.W. DK Tech Co., Ltd., Statement of Work
- 2.3 ISO 10012-1 Quality Assurance Requirements for Measuring Equipment.
- 2.4 ANSI/NC SL Z540-1-1994 Calibration Laboratories and Measuring and Test Equipment General Requirements



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GARWOOD LABORATORIES, INC.

REPORT NO.: R24612-1

Page No.: 6 of 8

ENVIRONMENTAL TEST REPORT

3.0 SUMMARY

- 3.1 Four (4) Spool Assemblies were subjected to and completed the specified environmental test with results noted in Table II, and in the Test Data Sheets. See Appendix C for leak points.

TABLE II

SPOOL ID	LEAK RATE
A	$<1.3 \times 10^{-8}$ sccs
B	$<1.3 \times 10^{-8}$ sccs
C	$<1.3 \times 10^{-8}$ sccs
D	$<1.3 \times 10^{-8}$ sccs

- 3.2 The four (4) Spool Assemblies were returned to DK Tech Co., Ltd., for further evaluation after completion of testing.



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REPORT NO.: **R24612-1**

Page No.: **7 of 8**

ENVIRONMENTAL TEST REPORT

4.0 TEST CONDITIONS AND EQUIPMENT

4.1 Ambient Conditions:

Unless otherwise specified herein, all testing was performed at an atmospheric pressure of 28 ± 2.5 inches of mercury absolute, a temperature of 75 ± 15 °F, and a relative humidity of 50 ± 30 %.

4.2 Instrumentation and Equipment:

4.2.1 Measuring and test equipment, utilized in the performance of these tests, was calibrated in accordance with ISO 10012-1, former Mil-Std-45662A, and ANSI/NCSL Z540-1-1994, by Garwood Laboratories, Inc., or a commercial facility, utilizing reference standards (or interim standards) whose calibrations have been certified as being traceable to the National Institute of Standards & Technology (NIST). All reference standards utilized in the above calibration system are supported by certificates, reports, or data sheets attesting to the date, accuracy, and conditions under which the results furnished were obtained. All subordinate standards, measuring and test equipment are supported by like data, when such information is essential to achieve the accuracy control required by the procedure.

4.2.2 Garwood Laboratories, Inc., attests that the commercial sources providing calibration services on the above referenced equipment, other than the NIST Standards are in fact capable of performing the required services to the satisfaction of Garwood Laboratories, Inc., Quality Assurance. Certifications of all calibrations performed are retained on file in the Garwood Laboratories, Inc., Quality Assurance Department, and are available for inspection upon request by customer representatives.

4.2.3 The test equipment utilized during this test program is listed on individual Data Sheets, beginning on page number A-1 of this report.

4.3 Tolerances:

4.3.1 Unless otherwise stated, test conditions were maintained within the tolerances specified in the references of Para. 2.0.



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REPORT NO.: **R24612-1**

Page No.: **8 of 8**

ENVIRONMENTAL TEST REPORT

5.0 TEST SEQUENCE

- 5.1 The specified test of Helium Leak was conducted on September 14, 2001.

6.0 TEST METHODS AND RESULTS

6.1 HELIUM LEAK

(Ref.: Nelson-Dunn, Inc. S.O.W.)

- 6.1.1 Four (4) Spool Assemblies, P/N: Spool A, Spool B, Spool C, and Spool D, S/N: N/A, were individually set-up to a mass spectrometer. The Spool Assemblies were pre-assembled by the customer. See photo(s) of set-up.
- 6.1.2 Each of the four (4) Spool Assemblies were then pressurized to 5000 psig with helium.
- 6.1.3 Each individual test unit was then checked for leaks using a fixed probe connected to the mass spectrometer.
- 6.1.4 The mass spectrometer was calibrated to a standard leak rate of 3.1×10^{-8} sccs.
- 6.1.5 The four (4) Spool Assemblies completed the helium leak test with leak rates of less than 1.3×10^{-8} sccs. See Data Sheets. See Table II.
- 6.1.6 The four (4) Spool Assemblies, P/N: Spool A, Spool B, Spool C, and Spool D, S/N: N/A, were considered to have met the requirements of the Helium Leak Test, as conducted by Garwood Laboratories, Inc., in accordance with DK Tech Co., Ltd., Statement of Work.
- 6.2 The four (4) Spool Assemblies were returned to DK Tech Co., Ltd., for further evaluation after completion of the test.



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JOB NO.: R24612-1

Page No.: B-1

ENVIRONMENTAL TEST SETUP PHOTOGRAPH(S)

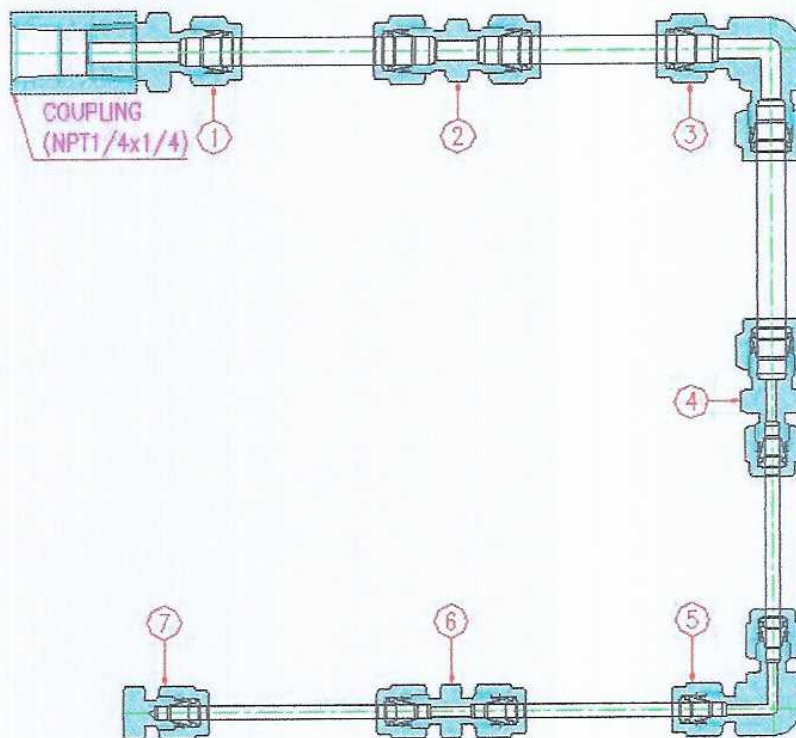
HELIUM LEAK
FOUR (4) SPOOL ASSEMBLIES
P/N: SPOOL A, B, C, D, S/N: N/A



SPOOL NO. A

DETAILS OF SPOOL ARRANGEMENT

Sub.: S316 Dk-Lok Helium Leak Test	Garwood Job No.:
Page: 3 of 6	Page No.:



For tube fitting O.D. 1/8" and 1/4"

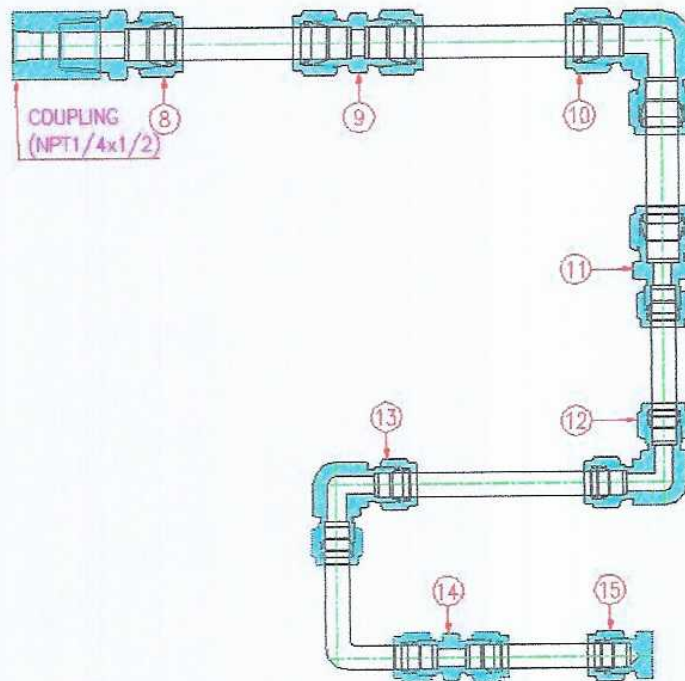
SR.NO.	Dk-Lok		Assembled Swagelok parts
	Part No.	Description	
1	DMC 4-4N	Male Connector 1/4" x 1/4"NPT	Nut
2	DU-4	Union 1/4"	Front & Back Ferrule, Body
3	DL-4	Union Elbow 1/4"	Front & Back Ferrule, Body
4	DUR 4-2	Reducing Union 1/4" x 1/8"	Front & Back Ferrule, Nut
5	DL-2	Union Elbow 1/8"	Front & Back Ferrule
6	DU-2	Union 1/8"	Front Ferrule, Nut, Body
7	DC-2	Cap 1/8"	Back Ferrule

Swagelok :TM of Swagelok Co .

SPOOL NO. B

DETAILS OF SPOOL ARRANGEMENT

Sub.: S316 Dk-Lok Helium Leak Test	Garwood Job No.:
Page: 4 of 6	Page No.:



For tube fitting O.D. 3/8" and 1/2"

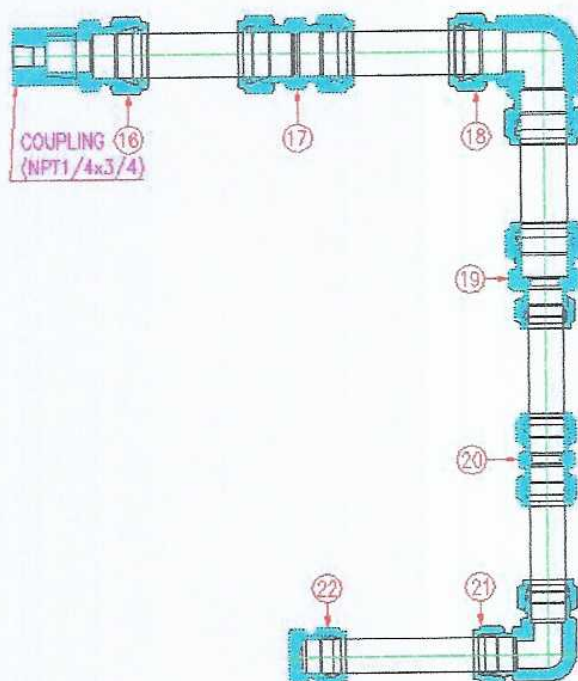
SR.NO.	Dk-Lok		Assembled Swagelok parts
	Part No.	Description	
8	DMC 8-8N	Male Connector 1/2" x 1/2"NPT	Front Ferrule, body
9	DU-8	Union 1/2"	Front & Back Ferrule, Nut, Back Ferrule
10	DL-8	Union Elbow 1/2"	Front Ferrule, Nut, Nut
11	DUR 8-6	Reducing Union 1/2" x 3/8"	Front & Back Ferrule
12	DL-6	Union Elbow 3/8"	Front & Back Ferrule, Nut
13	DL-6	Union Elbow 3/8"	Front Ferrule, Nut
14	DU-6	Union 3/8"	Front & Back Ferrule, Nut
15	DC-6	Cap 3/8"	Nut

Swagelok: TM of Swagelok Co

SPOOL NO. C

DETAILS OF SPOOL ARRANGEMENT

Sub.: S316 Dk-Lok Helium Leak Test	Garwood Job No.:
Page: 5 of 6	Page No.:



For tube fitting O.D. 3/4" and 1"

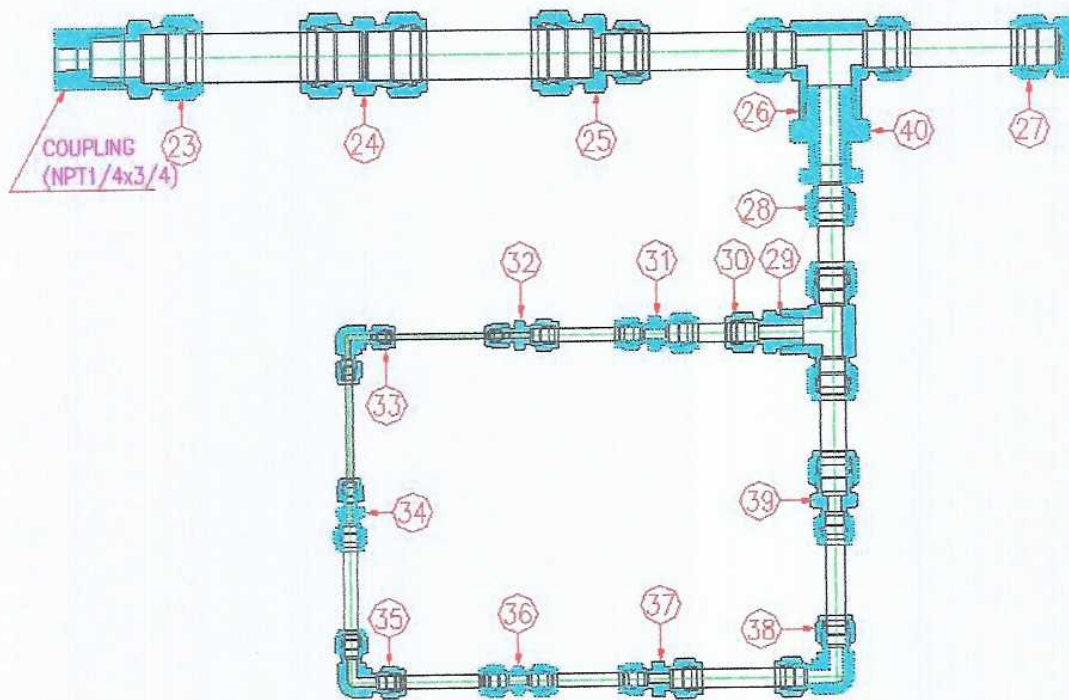
SR.NO.	Dk-Lok		Assembled Swagelok parts
	Part No.	Description	
16	DMC 16-12N	Male Connector 1" x 3/4"NPT	Front Ferrule
17	DU-16	Union 1"	Front & Back Ferrule, Body
18	DL-16	Union Elbow 1"	Nut
19	DUR 16-12	Reducing Union 1" x 3/4"	Front & Back Ferrule, Front & Back Ferrule
20	DU-12	Union 3/4"	Nut, Body, Nut
21	DL-12	Union Elbow 3/4"	Front & Back Ferrule, Nut Nut
22	DC-12	Cap 3/4"	Front & Back Ferrule

Swagelok: TM of Swagelok Co

SPOOL NO. D

DETAILS OF SPOOL ARRANGEMENT

Sub.: S316 Dk-Lok Helium Leak Test	Garwood Job No.:
Page: 6 of 6	Page No.:



For Dk-Lok tube fitting O.D. 1/8" to 1"

SR.No.	Dk-Lok		SR.No.	Dk-Lok	
	Part No.	Description		Part No.	Description
23	DMC 16-12N	Male Connector 1" x 3/4" NPT	32	DUR 4-2	Reducing Union 1/4" x 1/8"
24	DU-16	Union 1"	33	DL-16	Union Elbow 1/8"
25	DUR 16-12	Reducing Union 1" x 3/4"	34	DUR 4-2	Reducing Union 1/4" x 1/8"
26	DTBF 12-12N	Female Branch Tee 3/4" x 3/4" NPT	35	DL-4	Union Elbow 1/4"
27	DC-12	Cap 3/4"	36	DU-4	Union 1/4"
28	DCF 8-12N	Female Connector 1/2" x 3/4" NPT	37	DUR 6-4	Reducing Union 3/8" x 1/4"
29	DTBF 8-6N	Female Branch Tee 1/2" x 3/8" NPT	38	DL-6	Union Elbow 3/8"
30	DMC 6-6N	Male Connector 3/8" x 3/8" NPT	39	DUR 8-6	Reducing Union 1/2" x 3/8"
31	DUR 6-4	Reducing Union 3/8" x 1/4"	40	GNR 12-8N	Hex Reducing Nipple

Dk-Lok TM of DK Tech Co.,Ltd.

1.23 x 10⁻⁸ $\frac{cc}{a}$ On a standard number it is: 0.000000128 $\frac{cc}{a}$

Making this flow rate generally understood one might do any of the following:

$$1.28 \times 10^{-8} \frac{cc}{a} \times \frac{3600a}{1h} \times \frac{24h}{1day} \times \frac{365.25days}{1yr} = 4.0394 \times 10^{-1} \frac{cc}{yr} = 0.40394 \frac{cc}{yr}$$

$$0.40394 \frac{cc}{yr} \times \frac{1L}{1000cc} \times \frac{1.057gt}{1L} = 4.2696 \times 10^{-4} \frac{gt}{yr} = 0.00042696 \frac{gt}{yr}$$

$$0.00042696 \frac{gt}{yr} \times \frac{1L}{1.057gt} \times \frac{1000cc}{1L} \times \frac{1tap}{8cc} = 5.0492 \times 10^{-2} \frac{tap}{yr} = 0.050492 \frac{tap}{yr}$$

$$0.050492 \frac{tap}{yr} \times \frac{approx}{12drops} = 6.0571 \times 10^{-1} \frac{drops}{year}$$

or

$$0.06591 \frac{drop}{yr}$$

It would take 602.81 years to pass one drop ($\frac{1}{12}$ tap)

Yes! No! No!

SCS : { STANDARD
cu ft
CENTIMETER
per second.