

FLOW-DAQ

REV 1.02
2008

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1.

1.1

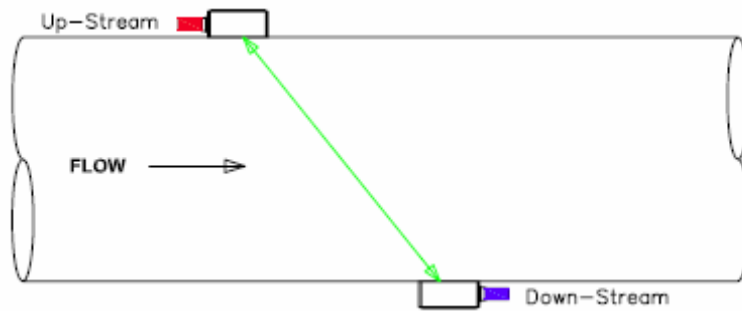
Uisoflow 309F

Uisoflow 309F 가 10,000 ppm () 가

Uisoflow 309F

1.2

가 가
() ()
UisoFlow 309F
, (1).
..



- 1 -

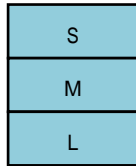
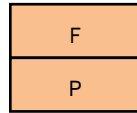
1.3 *Uisoflow 309F*

±1%. 0.5%, 0.2% .
()
RS-232
40 DC DC (8~36 VCD)
가
1 2

1.4

- HVAC
- (가),
-
-
-
-
-
-
-
-
-

1.5



(DN15~DN100/mm)

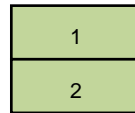
(DN50~DN1000/mm)

(DN300~DN6000/mm)



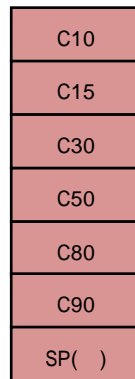
(0~80)

(0~160)



110 VAC ()

220 VAC



(10 meter Cable)

15 meter Cable

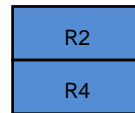
30 meter Cable

50 meter Cable

80 meter Cable

100 meter Cable

By order Max 300 meter Cable



RS 232 Serial Interface

RS 485 Serial Interface()

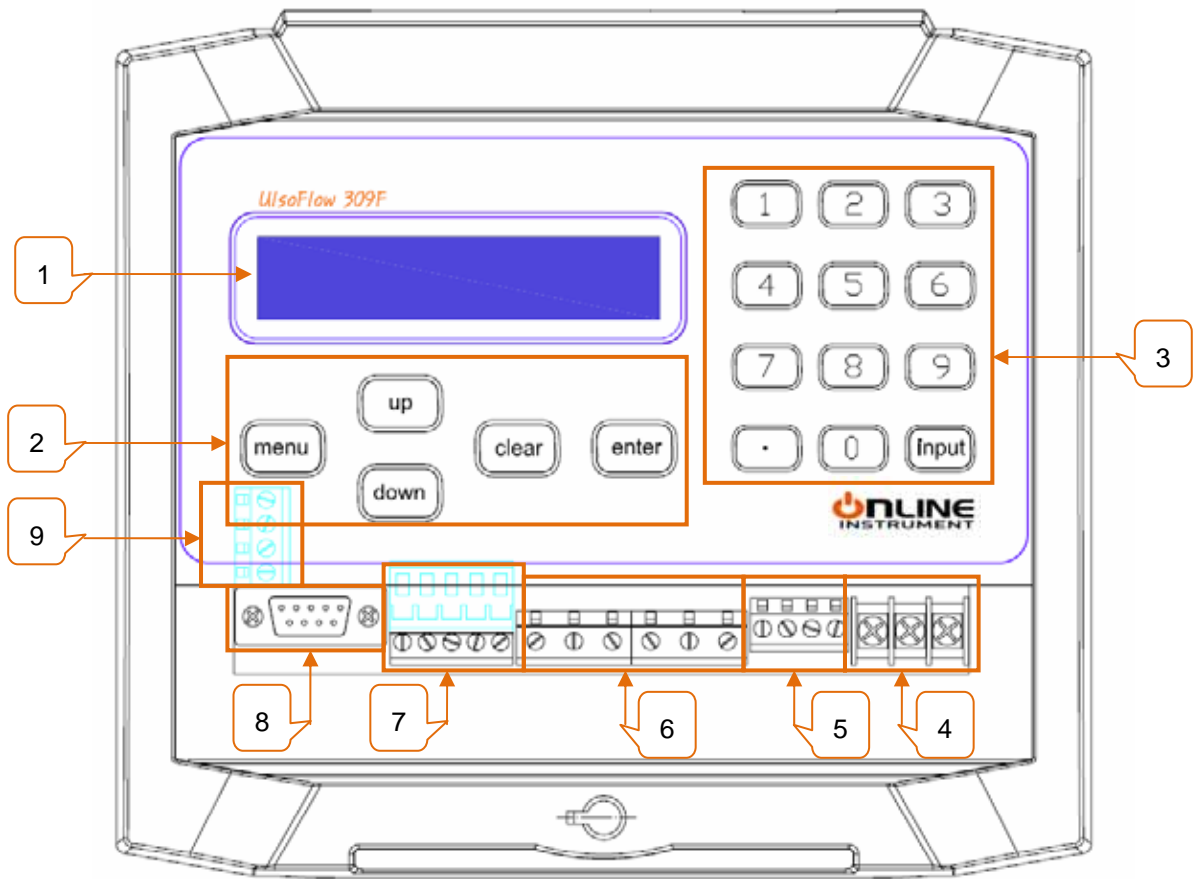
Ulsoflow 309 F – M – N – 2 – C10 – R2

Uniflow 309 - - - 220VAC
 - 10 meter - Rs 232

1.6

<i>Transmitter</i>	
Accuracy	Better than $\pm 1\%$ of Reading at Velocity $>0.2\text{m/sec}$
Repeatability	0.2 %
Linearity	0.5 %
Response Time	0.5 sec
Velocity Range	± 32 m/sec, bi-directional
Measurement Time	40 pico-second
Display	40 Character(2 line x 20) Alphanumeric Backlight Blue LCD Flow rate/Totalizer(Pos.Net,Neg)/Velocity/Date & Time/Error message etc.
Power Supply	220VAC, 50/60Hz and 8~26VDC
Power Consumption	Less than 2W
Output	Analog Output : 0/4~20mA (Max road 750) Pulse Output : 0~9999Hz, Open Collector Relay output : SPST Max 1Hz
Input	Max 5 Channel Analog Input (4~20mA)
Communication	RS 232 Serial Interface (st), RS485(op)
History	Last 64 data of Day/Month/Year totalizer, On/Off event.
Environment	Temperature : -30~80 , Humidity : 85% RH
Protection Rate	IP 65
Liquid Type	Virtually all non-aerated homogeneous liquids
Liquid Temperature	0 ~ 100
Security	System Lock, Keypad lock by user selected access code
Conduit Connector	PG 13.5
Enclosure Material	Main Box & Protection Cover : ABS, Clear Window : Polycarbonate
Size	199(W) x 180(H) x 105(D) (unit : mm)
Weight	Approx : 1.4 Kg
<i>Transducer</i>	
Application Size	S : DN 15mm ~ DN 100mm (Option) M : DN 50mm~DN 1000mm (Standard) L : DN 300mm ~ DN 6000mm (Option)
Pipe Material	Most material of Pipe (11 kinds of material at menu list and others)
Cable Length	9 meter (st), Max 300m as 15, 30, 50, 100 ,150, 200, 250, 300 meter
Working Temperature	-40 ~ 100
Protection Rate	IP 68

1.7



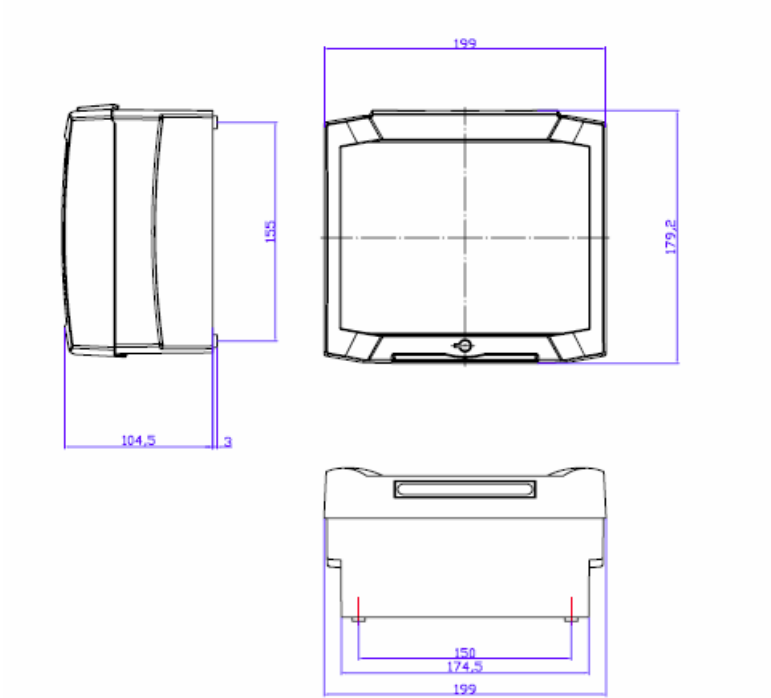
- 2 -

- 1. LCD : ()
- 2. : .
- 3. :
- 4. AC : .
- 5. DC .
- 6. : .
- 7. , .
- 8. DB9 Rs232
- 9. RS 485 (Option)

2.

2.1

2.1.1 (: mm)

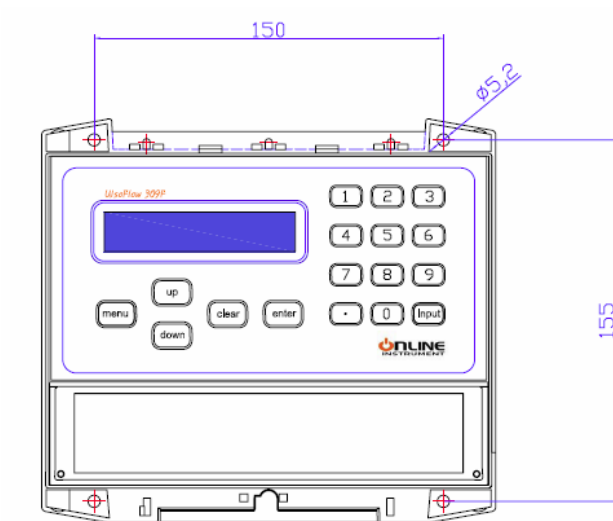


- 3 -

2.1.2 (: mm)

4mm

5.2mm

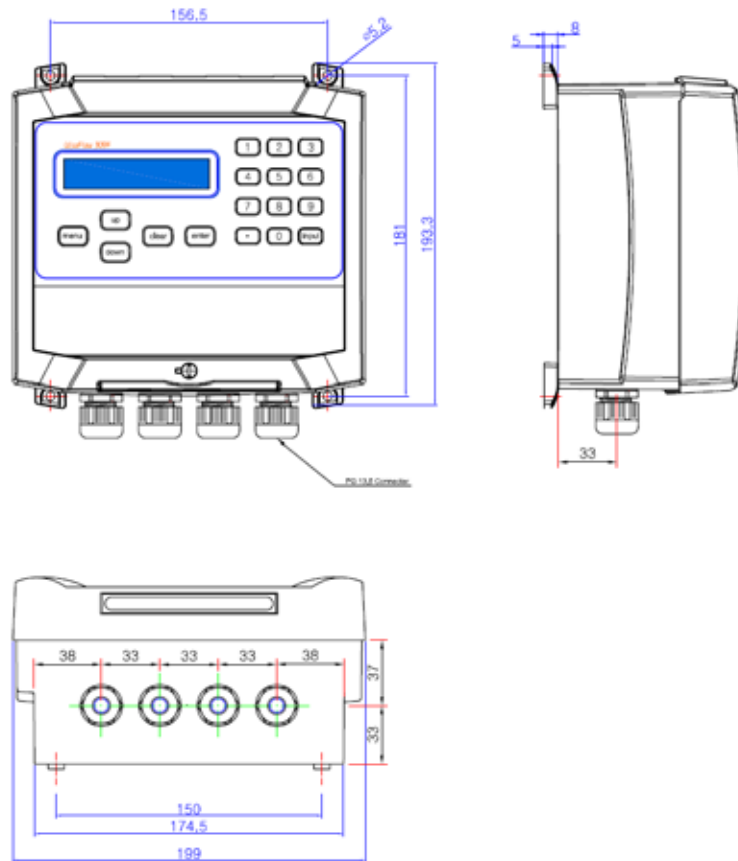


- 4 -

2.1.3

(: mm)

3mm



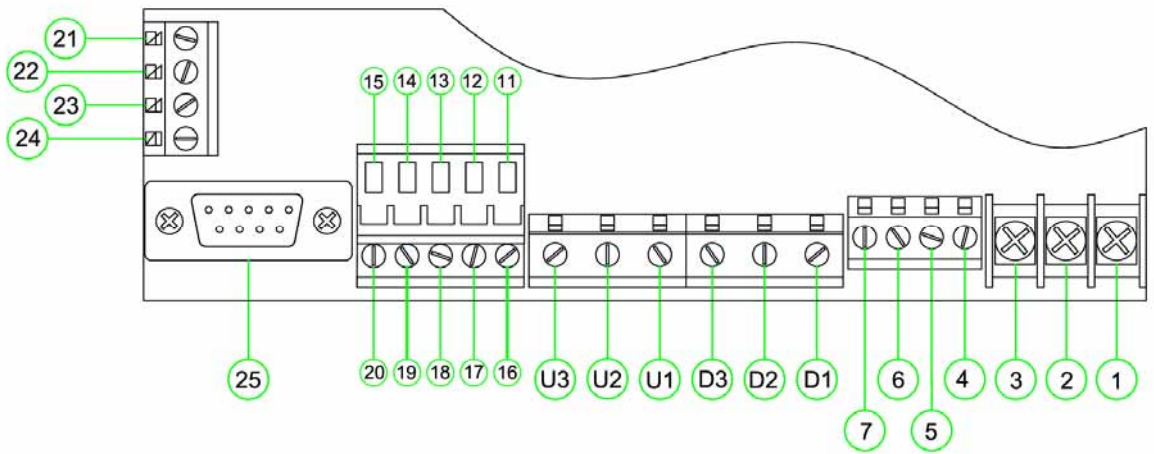
- 5 -

2.2





(_____)



- 6 -

2.2.1

가 AC220V

<i>Note:</i>	DC 8-36V	AC 7-30V	220V	
— DC	(+) (-)			가

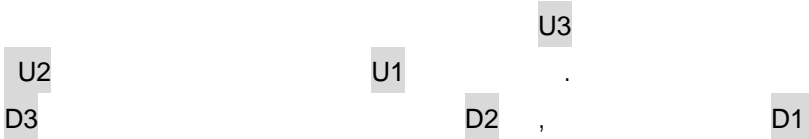
- 1. 220 V AC
- 2. 10-36VDC

DC

2.2.2

“ 6” . *UISOflow 309F*

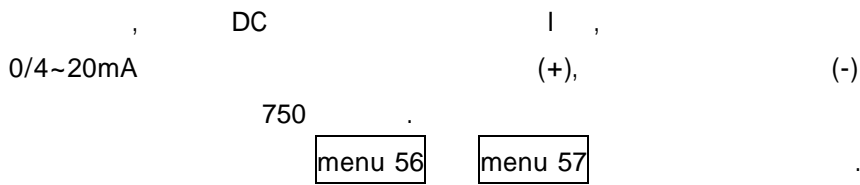
가
가



2.3.3 &

2.3.3.1
0/4~20mA

DC



2.3.3.2 (Open Collector)

(+) (-)
0~9999H 가
4.11

2.3.3.3

Uisoflow 309F

가

Open

Close

가

:

menu 79

19

20

가

2.3.3.4 RS232/RS485

Uisoflow 309F

DB9 RS-232C

75-115200 baud

RS 232

(25). RS 485

RS-232

(25)

“ 2”

9

RS 485

A+, B-

22, 23

가

menu 62

Baud Rate

Rs-232C

RS-485

RS

485

“ 7

”

2.3.3.5

Uisoflow 309F

11

16 17 18

5

가

“ 2”

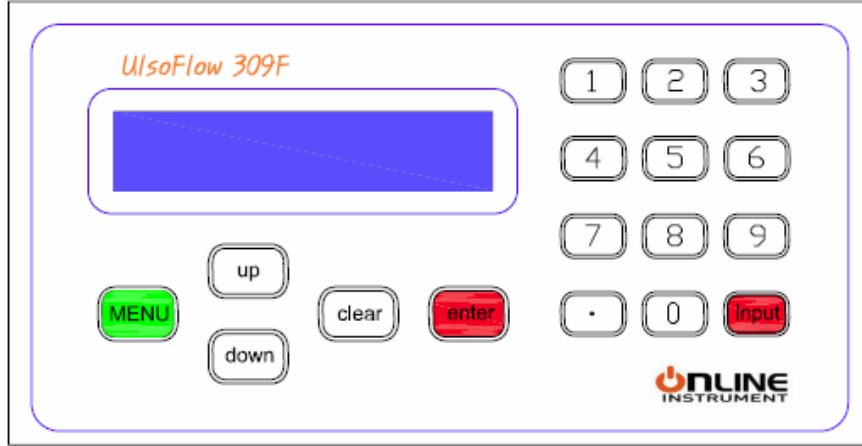
7

11

가

3.

3.1



- 7 -

40

가

- menu Key :
- up
 down
 Up & Down key : (+/up), (-/down)
- clear
 Clear Key : 가
- enter
 Enter Key :
- input
 Input key : "Enter" , MENU
- 0 ~ 9
 Numeric Keys : 0 ~ 9

3.2

3.2.1

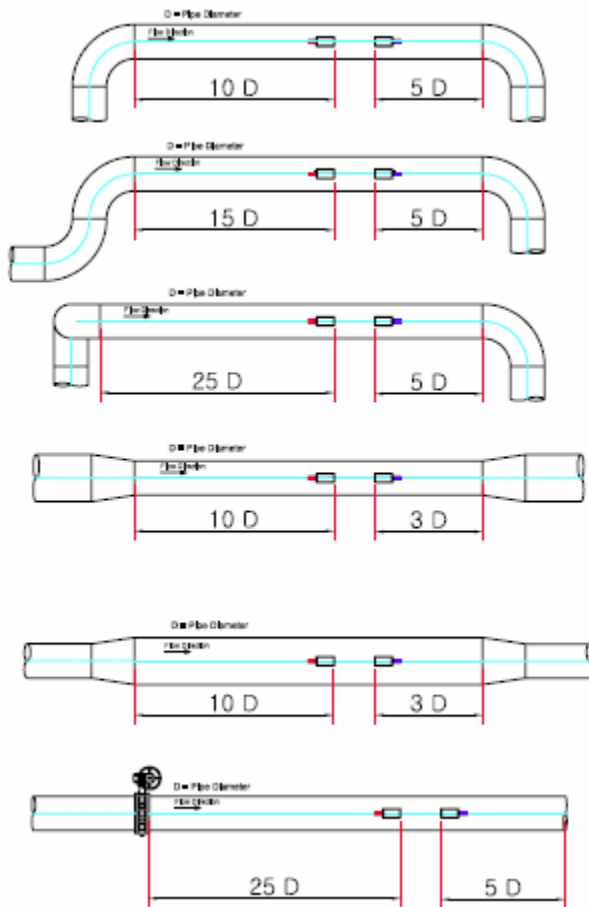
가 “ 8”
 가 . (“ ” “ ”)

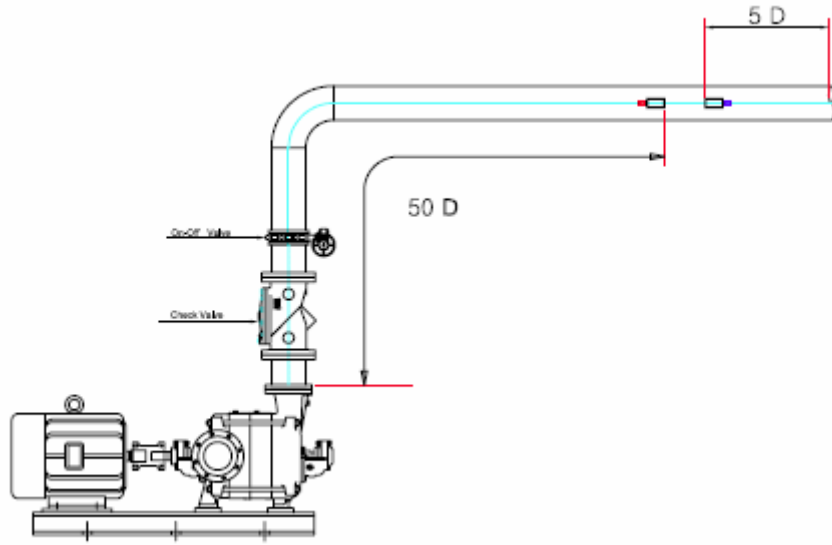
가 .

UISOflow 309F

가 V 4 W
 Z

(9 ~11)





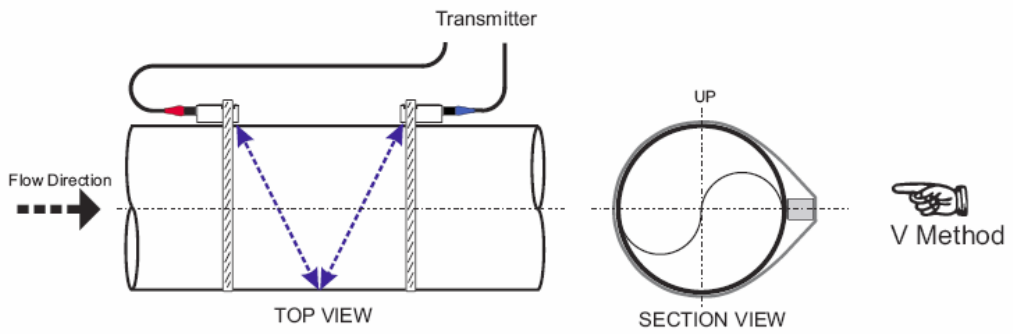
- 8 -

3.2.2

3.2.2.1 V

V

25mm 400mm (1 ~16)



- 9 -

3.2.2.2 W

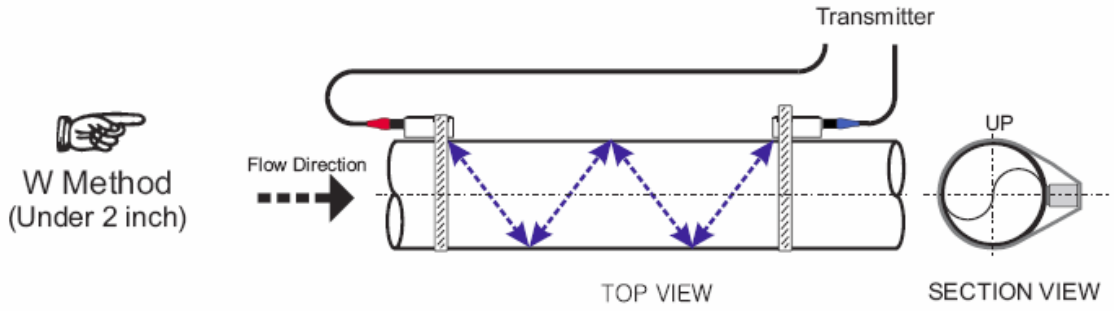
W

가

가

3

(50mm, 2").



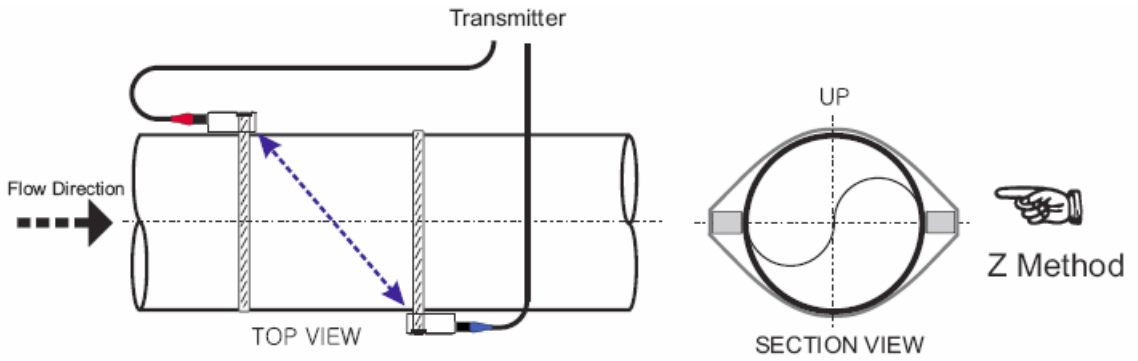
- 10 -

3.2.2.3 Z Method

Z V Z

Z 100~3000mm (4~120 Inch)

300mm (12 inch) Z



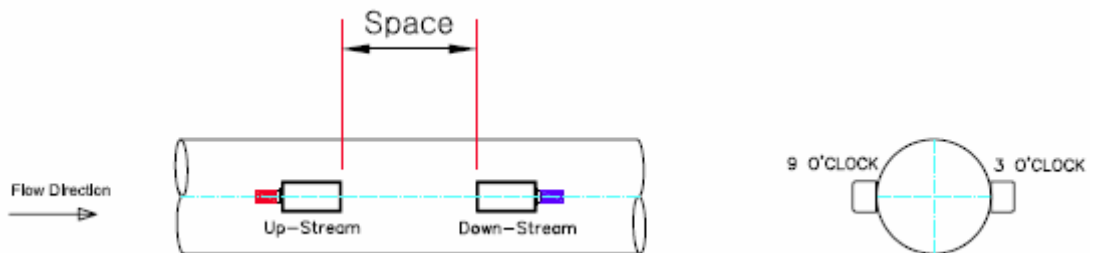
- 11 -

3.2.3

menu 25 (menu 11), (menu 12)

(menu 23), (menu 24)

. (12)



- 12 -



3 9
가 . (“ 12”)



가



12

3.3

가 가 가

“ ”

3.3.1 (menu 90)

(menu 90)

Uisoflow 309F

00.0 99.9

Strength + Quality [90
UP : 00.0 DN : 00.0 Q=00

.00.0

99.9

가

가

가

가

가 60.00

가

“Z”

3.3.2 (menu 90)

Q (menu 90)

. *Ulsoflow 309F*

Q 00.0~99.0

99

Strength + Quality [90]
UP : 00.0 DN : 00.0 Q=00

가

3.3.3

(menu 91)

가

가

100±3

menu 91

TOM / TOS * 100 [91]
0.0000 %

(1) (, ,)

(2) menu 25

(3) 가

(4) 가 , ,

가

3.3.4. (menu 93)

MENU 93

(Delta time)가

Total Time, Delta Time [93]
0.0000 uS 0.0386 nS

“Delta Time” ±20%



가

가

가

MENU25

가

가

0.00

)가

가

(

가

가

가

가



가

가

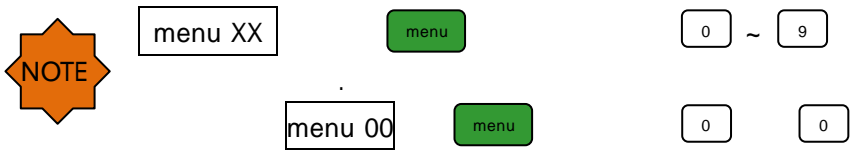
가

가



가

4.



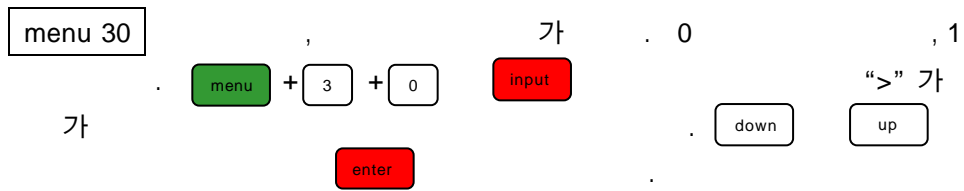
4.1 (menu + 0 + 8)

menu08

(*) 10가

“R” “J” “I” “H” “E” “Q” “F” “G” “K” “H” “Low Signal Strength”
 “Poor Signal Quality” 가 Isoflow 309F
 LCD 가 menu 00 ~ menu 05
 “R”
 6 “ ”

4.2 (menu + 3 + 0)



4.3 (menu + 3 + 1)



4.4 (menu + 3 + 2)

menu 32

4.3

4.5 (menu + 3 + 3)

menu 33

4.6 On/Off. (menu + 3 + 4 , 5 , 6)

menu 34
menu 35
menu 36

ON/OFF
ON/OFF
ON/OFF

4.7 (menu + 3 + 7)

menu 37

4.8 (menu + 3 + 7 + ,)

menu + 3 + 7 menu 37 ,

4.9 (menu + 4 + 0)

menu 40

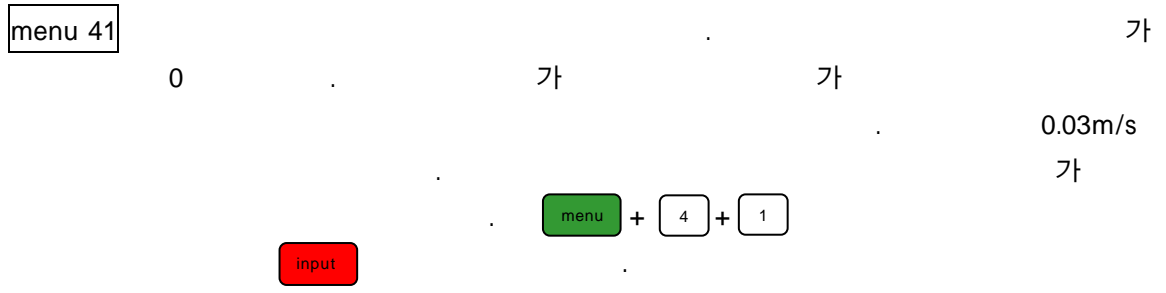
가

10

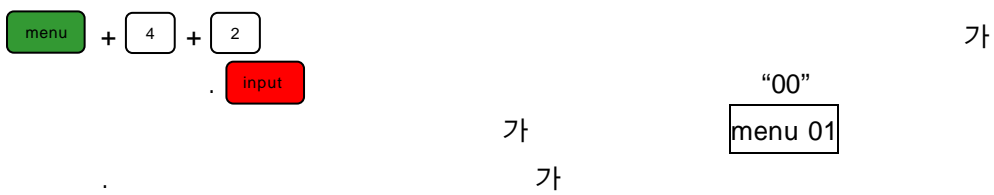
input

menu + 4 + 0³

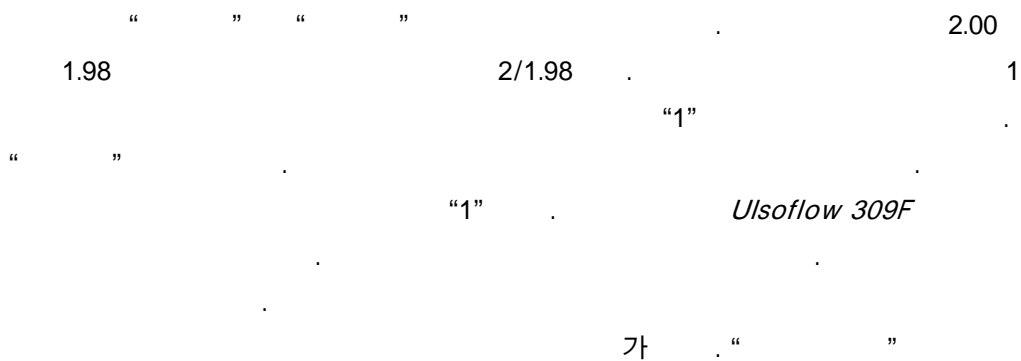
4.10 (menu + 4 + 1)



4.11 (menu + 4 + 2)

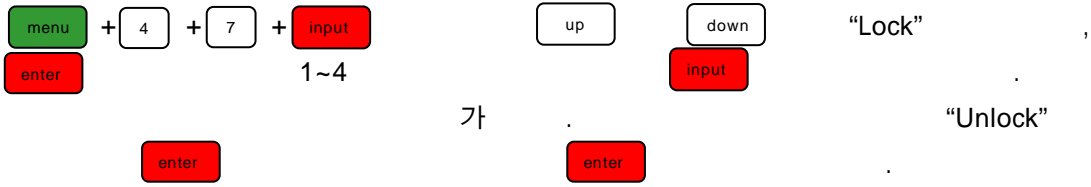


4.12 (menu + 4 + 5)



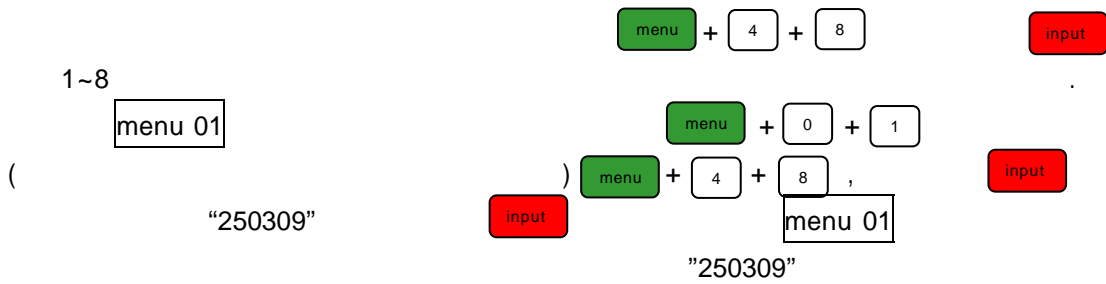
4.13 & (menu + 4 + 7)

가

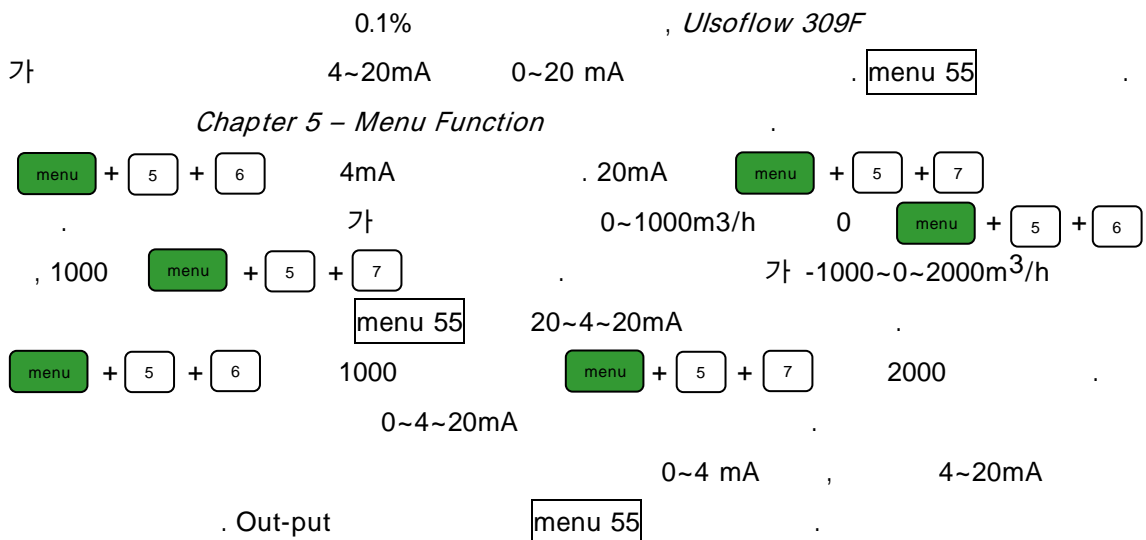


4.14 (menu + 4 + 8)

가



4.15 4~20mA (menu + 5 + 5)



-1000 menu + 5 + 6 , 2000 menu + 5 + 7
 menu 58
 menu + 5 + 5 + input up down "0mA", "4mA", "8mA"
 "16mA", "20mA"
 가
 menu 59

4.16 (menu + 6 + 8 , 9)

Uisoflow 309F

가 0~3000m³/h

123~1000Hz

- menu + 6 + 8 (low limit frequency output flow value), input 0;
- menu + 6 + 9 (high limit frequency output flow value), input 3000;
- menu + 6 + 8 (low limit frequency), input 123;
- menu + 6 + 9 (high limit frequency), input 1000.

가 OCT

menu 78 13 (item "13. FO").

4.17 (menu + 7 + 9)

Uisoflow 309F

가

4.4 4.5

OCT (menu 78 menu79). OCT

0.1 m³

- menu + 3 + 3 , "Cubic Meters" (m³) "
- menu + 3 + 4 , "2. x0.1 "
- menu + 7 + 9 , "9. Positive totalizer Pulse output" ;



가 가 1~60

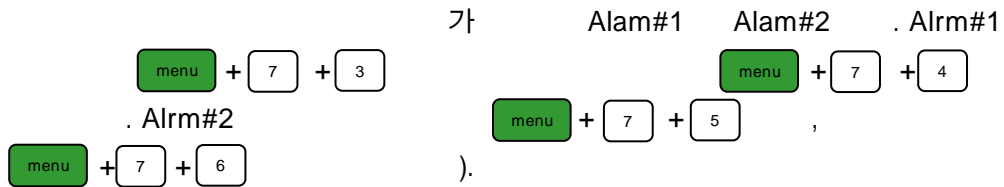
4.18 (menu + 7 + 3 , 4 , 5 , 6)

Ulsflow 309F 가
On-Off

menu 77

on-off OCT Normal Open Normal Close
On-Off

1. ;
2. ;
3. 가 ;
4. 가 (back flow).
5. 120%
6. 120%
7. ()



Example 1: 가 가 :
menu 77 "2. Abnormal Measurement State" :

Example 2: 300~1000m³/h :
 menu + 7 + 3 , 300 ;
 menu + 7 + 4 , 1000 ;
 menu + 7 + 9 , "6. Alarm #1 limit exceed"

Example 3: 100~500m³/h OCT , 600~1000m³/h
:
 menu + 7 + 3 , 100 ;

- menu + 7 + 4 , 500 ;
- menu + 7 + 5 , 600 ;
- menu + 7 + 6 , 1000 ;
- menu + 7 + 8 , "6. Alarm #1 limit exceed" .
- menu + 7 + 9 , "6. Alarm #1 limit exceed" .

4.19 (menu + 7 + 7)

() : 가 가
 ... menu 77 . 가

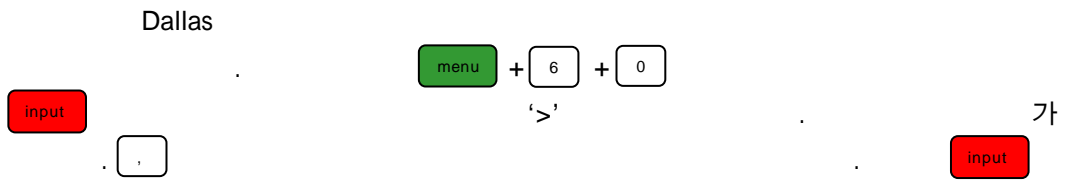
4.20 (menu + 7 + 8)

Normal-open Normal-close
 Collect : 가 Open Close
 : OCT 가 27 28
 27 28 Collector Emitter-collector가
 menu 78

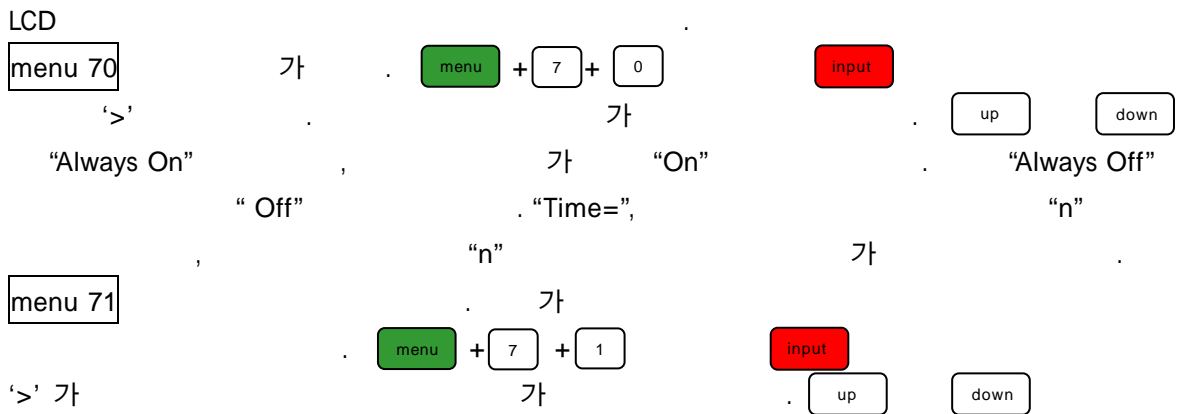
4.21 (menu + 7 + 9)

Uisoflow 309F 가
 Open Close : 가
 가 menu 79
 29 30

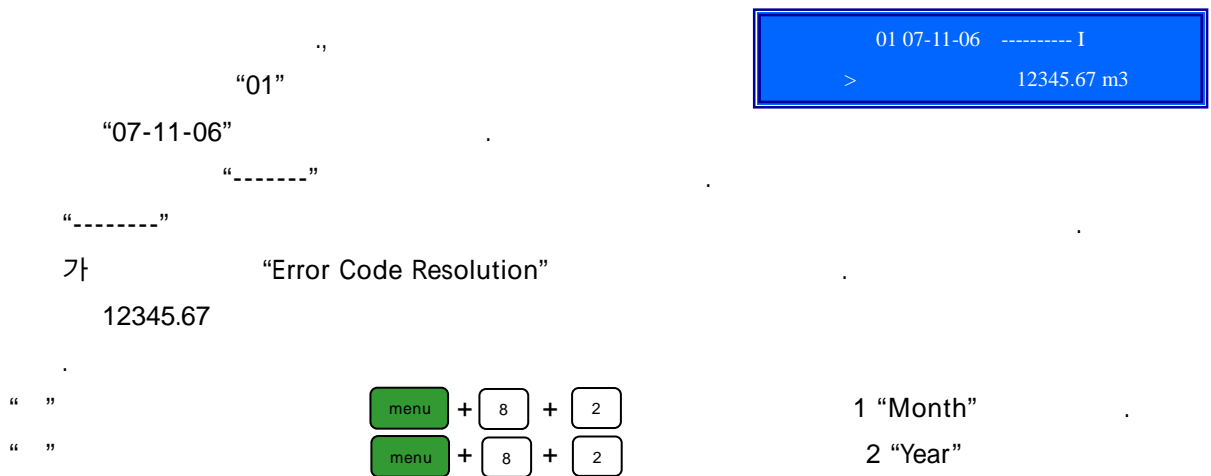
4.22 (menu + 6 + 0)



4.23 (menu + 7 + 0)



4.24 (menu + 8 + 2)



4.25 (menu + 8 + 3)

menu 83 "Yes"
"No"

4.26 (menu + 7 + 2)

menu 72
input "Yes"

4.27 (menu + 3 + 8)

menu + 3 + 8 + input
enter or input

4.28

(Volume)
Uisoflow 309F
OCT
input 2mA
가 "1" 가 "0" "0"
menu 80 menu 70(OCT output) menu 79
(Relay output) 8 " output as batch controller" OCT
Relay Output menu 81
가 "5"

4.29

menu 58
가
menu + down + 0 + input "4213068" input
menu + down + 5 + input 4mA
up down

5.

5.1

Group	Description	Menu No	Group	Description	Menu No
Display	Flow rate & Net Totalizer	menu 00	Current Loop Output	Current Loop Mode	menu 55
	Flow rate & Velocity	menu 01		Input 4 mA value	menu 56
	Flow rate & Positive Totalizer	menu 02		Input 20 mA Value	menu 57
	Flow rate & Negative Totalizer	menu 03		Current Loop Checkup	menu 58
	Date, Time & Flow rate	menu 04		Current Loop Output Display	menu 59
	Caloric / Total Caloric	menu 05	Identify Data	Date & Time Setting	menu 60
	Analog input Value	menu 06		Software Version	menu 61
	System Error Code	menu 08	Analogue Input	Analogue Input 1 value	menu 63
	Net Flow Today	menu 09		Analogue Input 2 value	menu 64
Pipe Parameter	Pipe Outer Diameter	menu 11	Frequency Output Setup	Frequency Range of F.O	menu 67
	Pipe Wall Thickness	menu 12		Low Frequency output of Flow Rate	menu 68
	Pipe Inner Diameter	menu 13		High Frequency output of Flow Rate	menu 69
	Pipe Material	menu 14	LCD Option	LCD Backlight option	menu 70
	Pipe Sound Velocity	menu 15		LCD Contrast	menu 71
Liner Parameter	Linear Material	menu 16	Timer	Working Timer	menu 72
	Liner Sound Velocity	menu 17	Alarm Setup	Low Value of Alarm No 1	menu 73
	Linear Thickness	menu 18		High Value of Alarm No 1	menu 74
Fluid Parameter	Fluid Type	menu 20		Low Value of Alarm No 2	menu 75
	Fluid Sound Velocity	menu 21		High Value of Alarm No 2	menu 76
	Fluid Viscosity	menu 22	Other Output & Option	Beeper Setup	menu 77
Transducer Parameter	Transducer Type	menu 23		PULSE output Setup	menu 78
	Transducer Mounting Method	menu 24		Relay Output Setup	menu 79
	Transducer Mounting Space	menu 25		Select Batch Control Input Signal	menu 80
Extra Function	Parameter SAVE	menu 26		Batch Controller Setup	menu 81
	Cross-sectional Area	menu 27		Date Totalizer	menu 82
	Hold previous data	menu 28		Automatic Flow Correction	menu 83
Flow Rate Setup	Measurement Unit	menu 30	Caloric Meter Option	Energy Unit Selection	menu 84
	Flow Rate Unit	menu 31		Temperature Selection	menu 85
Totalizer Setup	Totalizer Unit	menu 32		Specific Heat Selection	menu 86
	Totalizer Multiplier	menu 33		Energy Totalizer ON/OFF	menu 87
	Net Totalizer On/Off	menu 34		Energy Multiplier	menu 88
	Positive Totalizer On/Off	menu 35	Reset Energy Totalizer	menu 89	
	Negative Totalizer On/Off	menu 36	Diagnoses	Signal Strength & Signal Quality	menu 90
	Totalizer Reset	menu 37		TOM/TOS x 100	menu 91
	Manual Totalizer	menu 38		Fluid Sound Velocity	menu 92
Calibration	Damping	menu 40		Total Time & Delta Time	menu 93
	Low Flow Cutoff Value	menu 41	Reynolds Number & Factor	menu 94	
	Set Zero	menu 42	Extra Function	Power On/Off Time	menu+up 0
	Reset Zero	menu 43		Total Work Hours	menu+up 1
	Manual Zero Calibration	menu 44		Last Power Off Time	menu+up 2
	Scale Factor	menu 45		Last Power Rate	menu+up 3
Option	Network Identifying Address Code	menu 46		ON/OFF Times	menu+up 4
	System Lock	menu 47	Calculator	menu+up 5	
	Keypad Lock Code	menu 48			

5.2

menu 0 0 (/)
 (menu 34),

Flow 22.5 m3/h * R
 NET 10 x 1 m3

menu 0 1 (/)

Flow 22.5 m3/h * R
 Vel 0.456 m/s

menu 0 2 (/)
 menu 31

Flow 22.5 m3/h * R Pos
 15 x 1 m3

menu 0 3 (/)
 menu 31

Flow 22.5 m3/h * R Neg
 15 x 1 m3

menu 0 4 (, /)
 menu 60

07-11-01 20:21:22 * R
 Flow 22.5 m3/h

menu 0 5 (/)

EER 0.0000GJ/h * R E.T
0E+0 GJ

menu 0 6 ()

AI 1 = 0.0111 - 12.437
AI 2 = 0.0114 - 12.437

AI1, AI2

menu 0 8 ()

R -----R
System Normal

가

6-2

menu 0 9 ()

Net Flow Today M09
123.456 M3

menu 1 1 ()

Pipe outer Diameter
89.1 mm

menu 10

10mm~6000mm

Note:

menu 1 2 ()

Pipe Wall Thickness
0.5 mm

menu 13

menu 1 3 ()
 가 down ()
 Note:

Pipe Inner Diameter
 80 mm

menu 1 4 ()
 .(up down)
 8 "Other"
 9
 , 9
 menu 15

Pipe Material [14]
 0. Carbon Steel

Pipe Material [14]
 1. Stainless Steel

Pipe Material [14]
 2. Cast Iron

Pipe Material [14]
 3. Ductile Iron

Pipe Material [14]
 4. Copper

Pipe Material [14]
 5. PVC

Pipe Material [14]
 6. Aluminum

Pipe Material [14]
 7. Asbestors

Pipe Material [14]
 8. Fiberglass-Epoxy

Pipe Material [14]
 9. Other

menu 1 5 ()

Other

menu 14

Pipe Sound Velocity
1482.9 m/s

menu 1 6 ()

10

11

, Other

menu 17

Other

Liner Material [16]
0. None Liner

Liner Material [16]
1. Tar Epoxy

Liner Material [16]
2. Rubber

Liner Material [16]
3. Mortar

Liner Material [16]
4. Polypropylene

Liner Material [16]
5. Polystyrol

Liner Material [16]
6. Polystyrene

Liner Material [16]
7. Polyester

Liner Material [16]
8. Polyethylene

Liner Material [16]
9. Ebonite

Liner Material [16]
10. Teflon

Liner Material [16]
11. Other

menu 1 7 ()

menu 16

“Other”

Liner Sound Velocity
2007 m/s

menu 1 8 ()

menu 16

“Other”

Liner Thickness
11 mm

menu 2 0 ()

menu 21

“Other”

Fluid Type [20
0. Water

Fluid Type [20
1. Sea Water

Fluid Type [20
2. Kerosene

Fluid Type [20
3. Gasoline

Fluid Type [20
4. Fuel Oil

Fluid Type [20
5. Crude Oil

Fluid Type [20
6. Propane (-45C)

Fluid Type [20
7. Butane (0C)

Fluid Type [20
8. Other

Fluid Type [20
9. Diesel oil

Fluid Type [20]
10. Castor Oil

Fluid Type [20]
11. Peanut Oil

Fluid Type [20]
12. Gasoline #90

Fluid Type [20]
13. Gasoline #93

Fluid Type [20]
14. Alcohol

Fluid Type [20]
15. Water (125 C)

menu 2 1 ()

menu 20

“Other”

Menu 20

Fluid Sound Velocity
1234 m/s

menu 2 2 ()

menu 20

“Other”

Menu 20

Fluid Viscosity
1.0038 cSt

menu 2 3 ()

“10. Standard M1”

Transducer Type
10. Standard M1

DN 50~DN700

“11. Standard S1” DN15~DN100

“12.standard L1” DN300~DN6000

“S1” “L1”

- #0~#9가

menu 2 4 ()

V : V 가 1
가

Z : Z 가

(250mm

)

N : N 가 3

W : W 가 3

Transducer Mounting
0. V

Transducer Mounting
1. Z

Transducer Mounting
2. N

Transducer Mounting
3. W

menu 2 5 ()

Transducer Spacing
23.4 mm

.(
).
가

menu 2 6 ()

18 가

- 0. Entry to Save ()
- 1. Entry to Load ()
- 2. To Browse()

“Entry to Save”

enter

ID code 가

up

down

ID

enter

가 ID “Entry to Load”,

menu 25

Parameter Setup [26]
0. Entry to SAVE

Parameter Setup [26]
1. Entry to Load

Parameter Setup [26]
2. To Browse

menu 2 7 ()

Cross-Sectional Area
456.78 mm2

menu 2 8 ()

“Yes” 가

Hold with Poor Sig [28]
Yes

menu 3 0 ()

- 0. Metric()
- 1. English(,)

Measurement Unit in
0. Metric

Measurement Unit in
1. English

menu 3 1 ()

Flow Rate Units [31]
M3/h

Flow : Unit / Time
0.Cubic Meters (m3)

Flow : Unit / Time
1.Liters (l)

Flow : Unit / Time
2.US Gallons (GAL)

Flow : Unit / Time
3.Imperial Gallons

Flow : Unit / Time
4.Million Gallons (mg)

Flow : Unit / Time
5.Cubic Feet (cf)

Flow : Unit / Time
6.US Barrels (US bbl)

Flow : Unit / Time
7.Imperial Barrels

Flow : Unit / Time
8.Oil Barrels

가 가

Cubic meters (0)
/ Day

Cubic meters (0)
/ Hour

Cubic meters (0)
/ Min

Cubic meters (0)
/ Sec

menu 3 2 ()

Totalizer unit
0.Cubic Meters (m3)

Totalizer unit
1.Liters (l)

Totalizer unit
2.US Gallons (GAL)

Totalizer unit
3.Imperial Gallons

Totalizer unit
4.Million Gallons (mg)

Totalizer unit
5.Cubic Feet (cf)

Totalizer unit
6.US Barrels (US bbl)

Totalizer unit
7.Imperial Barrels

menu 3 3 ()

가

x1

Totalizer unit
8.Oil Barrels

Totalizer Multiplier
0. x 0.001 (1E-3)

Totalizer Multiplier
1. x 0.01

Totalizer Multiplier
2.x 0.1

Totalizer Multiplier
3. x 1

Totalizer Multiplier
4. x 10

menu 3 4 (On/Off)
 On/off "ON"
 , "OFF" 가
 . "OFF" 가

menu 00

"On"

menu 3 5 (On/Off)

On/off . "ON"
 , "OFF" 가
 . "OFF" 가

menu 02

"On"

menu 3 6 (On/Off)

On/off . "ON"
 , "OFF" 가
 . "OFF" 가

menu 03

"On"

menu 3 7 ()

enter ; up down

"YES" "NO"

"YES"

:

Totalizer Multiplier
 5. x 100

Totalizer Multiplier
 6. x 1000

Totalizer Multiplier
 7. x 10000 (1E+4)

NET Totalizer [34]
 ON

POS Totalizer [35]
 ON

NEG Totalizer [36]
 ON

Totalizer Reset ? [37]
 Selection

Select Totalizer
 > None

Select Totalizer
 > All

가
 . clear

menu 3 8 ()

enter

enter

menu 4 0 ()

0 999
 , 999

single-section RC filter

3 10

menu 4 1 ()

0

Select Totalizer
 > Net Totalizer

Select Totalizer
 > Pos Totalizer

Select Totalizer
 > Neg Totalizer

Select Totalizer
 > Energy Totalizer

Manual Totalizer [38
 Press ENT When Ready

Manual Totalizer [38
 ON 0 x m3

Damping [40
 5 sec

Low Flow Cutoff Val
 0.03 m/sec

0.03 가
 ±0.03 “0”
 0.03 ..

menu 4 2 (0)

Set Zero [42]
 Press ENT To go

가 Zero Point
 Zero Point가 Zero

Set zero 가
 ()
 “Zero Point”

enter 0
 Set Zero
 0 menu 43

menu 4 3 ()

Reset Zero [43]
 NO

가 “YES” 0

menu 4 4 ()

Manual Zero Point [44]
 0 m3/h

가
 0

= 150 m³/H

= 10 m³/H

= 140 m³/H

0

menu 4 5 ()

Scale Factor [45]
1

1

1

menu 4 6 ()

Network IDN [46]
88

0

65535, 13 (ODH ENTER),
10 (OAH Newline), 42 (2AH *) 38 (26H&)

menu 4 7 ()

System Lock [47]
**** Unlocked ****

가

가

가

1 4

(4.13

)

menu 4 8 ()

Keypad Lock Code [48]
Entry

가

가

(4.14.

)

menu 5 5 ()

0. 4-20mA Output Mode :
4-20mA

1. 0-20mA Output Mode :
0-20mA

2. RS232 controls 0-20mA :
Rs 232 Serial Port

3. 4-20mA 4~20mA
CL

4. 20-4-20mA Mode :
20-4-20mA

5. 0-4-20mA Mode :
0-4-20mA

6. 20-0-20mA Mode :
20-0-20mA

7. 4-20mA CL

8. 4-20mA CL

menu 5 6 (4mA)

4mA 0mA
(4mA 0mA menu 55)
menu 31
"velocity 4-20mA" 가 menu 55
m/s

CL Mode Select [55]
0. 4 - 20 mA

CL Mode Select [55]
1. 0 - 20 mA

CL Mode Select [55]
2. 0-20mA Via RS 232

CL Mode Select [55]
3. 0 - 20 mA vs Fluid

CL Mode Select [55]
4. 20 - 4 - 20 mA

CL Mode Select [55]
5. 0 - 4 - 20 mA

CL Mode Select [55]
6. 20 - 0 - 20 mA

CL Mode Select [55]
7. 4 - 20 mA vs. Vel

CL Mode Select [55]
8. 4 - 20 mA vs Energy

CL 4 mA Output Value
0 m3/h

menu 5 7 (20mA)

20mA

20mA.

menu 31

CL 20 mA Output Value
1000 m3/h

menu 5 8 ()

enter

input

up

down

0mA, 4mA

24mA

31 32

가 "4"

29 " "

CL Checkup [58]
Press ENT When Ready

menu 5 9 ()

10.0000mA가

10.00mA

가

CL Current Output [59]
4.0000 mA

menu 6 0 ()

. 24

enter

">" 가

YY-MM-DD HH:MM:SS
07-08-09 09:10:11

menu 6 1 ()

Ultrasonic Flowmeter
ESN = 07705919

(ESN)

가 . *Uiso*flow 309F 가

menu 6 3 (1)

AI 1 Value Range [63]
10 - 100

menu 63 4mA 20mA
. 10 4mA
100 20mA

menu 6 4 (2)

A2 1 Value Range [64]
10 - 100

menu 64 4mA 20mA
. 10 4mA
100 20mA

menu 6 7 ()

FO Frequency Range
1 - 1001

1-9999Hz 2000Hz

Note : Pulse Pulse

menu 6 8 ()

FO
 가 FO
 FO 가 1000Hz
 100m3/h (1000Hz
 100m3/h)

Low FO Flow Rate [68
 0 m3/h

menu 6 9 ()

FO
 가 FO

High FO Flow Rate [69
 1000 m3/h

menu 7 0 (LCD)

Always On” 가
 “Always Off” 가
 “Press On” ”N”
 “N”
 (“OFF”) “

LCD Backlit option
 0. Always OFF

LCD Backlit option
 1. Always ON

LCD Backlit option
 2. Lighting For

LCD Backlit option
 253 sec

menu 7 1 (LCD)

LCD enter
 up down
 가
 enter

LCD Contrast [71
 8

“8 ”

menu 7 2 ()

Uisoflow 309F

::

enter

"Yes"

Working Timer [72]
00000013 : 05 : 22

menu 7 3 (No 1)

menu 79

menu 78

가

Pulse

Alarm # 1 Low Value [73]
0 m3/h

menu 7 4 (No 1)

menu 79

menu 78

가

Pulse

Alarm # 1 Low Value [74]
1000 m3/h

menu 7 5 (No 2)

menu 79

menu 78

가

Pulse

Alarm # 2 Low Value [75]
0 m3/h

menu 7 6 (No 2)

Alarm # 2 Low Value [76]
1000 m3/h

menu 7 7 ()

가 .

BEEPER Setup 0 . No Signal	[77]
BEEPER Setup 1 . Poor Signal	[77]
BEEPER Setup 2 . Not Ready (No*R)	[77]
BEEPER Setup 3 . Reverse Flow	[77]
BEEPER Setup 4 . AO Over 100%	[77]
BEEPER Setup 5 . FO Over 120%	[77]
BEEPER Setup 6 . Alarm # 1	[77]
BEEPER Setup 7 . Alarm # 2	[77]
BEEPER Setup 8 . Batch Control	[77]
BEEPER Setup 9 . POS Int Pulse	[77]
BEEPER Setup 10. NEG Int Pulse	[77]
BEEPER Setup 1i. NET Int Pulse	[77]
BEEPER Setup 12. Energy Pulse	[77]
BEEPER Setup 13. ON/OFF via RS232	[77]
BEEPER Setup 14. Fluid Change	[77]

menu 7 8 (PULSE)

Pulse

가

BEEPER Setup [77]
15. Key stroking ON

BEEPER Setup [77]
16. Not Using

PULSE Output Setup [78]
0 . No Signal

PULSE Output Setup [78]
1 . Poor Signal

PULSE Output Setup [78]
2 . Not Ready (No*R)

PULSE Output Setup [78]
3 . Reverse Flow

PULSE Output Setup [78]
4 . AO Over 100%

PULSE Output Setup [78]
5 . FO Over 120%

PULSE Output Setup [78]
6 . Alarm # 1

PULSE Output Setup [78]
7 . Alarm # 2

PULSE Output Setup [78]
8 . Batch Control

PULSE Output Setup [78]
9 . POS Int Pulse

PULSE Output Setup [78]
10. NEG Int Pulse

menu 7 9 ()

“On”
가

PULSE Output Setup [78]
11. NET Int Pulse

PULSE Output Setup [78]
12. Energy Pulse

PULSE Output Setup [78]
13. FO

PULSE Output Setup [78]
14. FO via RS-232C

PULSE Output Setup [78]
15. ON/OFF via RS-232

PULSE Output Setup [78]
16. Fluid Change

PULSE Output Setup [78]
17. Not Using

RELAY Output Setup [79]
0. No Signal

RELAY Output Setup [79]
1. Poor Signal

RELAY Output Setup [79]
2. Not Ready (No*R)

RELAY Output Setup [79]
3. Reverse Flow

RELAY Output Setup [79]
4. AO Over 100%

RELAY Output Setup [79]
5. FO Over 120%

RELAY Output Setup [79]
6. Alarm # 1

RELAY Output Setup [79]
7 . Alarm # 2

RELAY Output Setup [79]
8 . Batch Control

RELAY Output Setup [79]
9 . POS Int Pulse

RELAY Output Setup [79]
10. NEG Int Pulse

RELAY Output Setup [79]
1i. NET Int Pulse

RELAY Output Setup [79]
12. Energy Pulse

RELAY Output Setup [79]
13. ON/OFF via RS-232

RELAY Output Setup [79]
14. Fluid Change

RELAY Output Setup [79]
15. Not using

menu 8 0 ()

Flow Batch CTRL by [80]
0 . Key Input

Flow Batch CTRL by [80]
1 . AI 1 Up Edge

Flow Batch CTRL by [80]
2 . AI 1 Down Edge

Flow Batch CTRL by [80]
3 . AI 2 Up Edge

Flow Batch CTRL by [80]
4 . AI 2 Down Edge

menu 8 1 ()

Uisoflow-309F

Pulse Relay

Flow Batch CTRL by [80
5 . AI 3 Up Edge

Flow Batch CTRL by [80
6 . AI 3 Down Edge

Flow Batch CTRL by [80
7 . AI 4 Up Edge

Flow Batch Controller
1000 x 1m3

menu 8 2 ()

64 , 64 5

enter up down

up down

가

Date Totalizer [82
0. Day

Date Totalizer [82
1. Day

menu 8 3 ()

Automatic Correction
ON

“NO”

menu 8 4 ()

: Giga Joule (GJ)
Kilo-calories . GJ

Energy Unit select
0. Giga Joule (GJ)

menu 8 5 ()

:
1. AI1 AI2
2.
"0. From AI1, AI2" AI1 AI2

Temperature Select
0. From AI 1, AI 2

Temperature Select
1. Fixed Difference

AI1 AI2 4~20
0~20
"1. Fixed Difference"

menu 8 6 ()

가 :
0.
1.
0.0041868GJ/M3

Specific Heat Select
0. Standard

Specific Heat Select
1. Fix specific Heat

menu 8 7 (On/Off)

"ON"
"OFF"

Energy Totalizer
> ON

Energy Totalizer
> OFF

menu 8 8 ()

: 10^{-4} -- 10^6 (E-4—E6)

Energy Multiplier [88
0. x 0.0001 (E-4)

Energy Multiplier [88
1. x 0.001 (E-3)

Energy Multiplier [88
2. x 0.01 (E-2)

Energy Multiplier [88
3. x 0.1 (E-1)

Energy Multiplier [88
4. x 1 (E0)

Energy Multiplier [88
5. x 10 (E1)

Energy Multiplier [88
6. x 100 (E2)

Energy Multiplier [88
7. x 1000 (E3)

Energy Multiplier [88
8. x 10,000 (E4)

Energy Multiplier [88
9. x 100,000 (E5)

Energy Multiplier [88
10. x 1,000,000 (E6)

menu 8 8 (Reset Energy Totalizer)

“YES”

Reset Energy Total
NO

menu 9 0 ()

Strength + Quality [90]
UP:00.0 DN:00.0 Q=00

Q
00.00~99.9
. 00.00 , 99.9
60.00 Q 00~99
, 00 99
Q 50

menu 9 1 (TOM/TOS x100)

TOM/TOS x 100 [91]
0.0000 %

100±3%
가
가
가
가

menu 9 2 ()

Fluid Sound Velocity
0.0000 m/s

menu 21
가 menu 21

menu 9 3 ()

Total Time , Delta Time
0.0000 uS , 4.478 nS

(:nS)
(:nS)

UisoFlow-309F

가
20% 가
가

menu 9 3 ()

Reynolds Number [94
0.0000 0.7500

UisoFlow-309F

menu up 0 (On/Off)

ON/OFF Time [+0
Press ENT When Ready

64 data On/Off

enter 64 On/Off

00 07-11-14 10 :49 :21
ON 0 m3/h

ON On

07-11-14 10:49:21 On

menu up 1 (가)

Uisoflow-309F

39 29 22 가

Total Work Hours [+1]
00000039 : 29 : 22

menu up 2 (OFF)

OFF

Last Power Off time [+2]
07-11-14 10 :49 :20

menu up 3 ()

Last Flow Rate [+3]
0 m3/h

menu up 4 (ON/OFF)

Uisoflow-309F ON/OFF

Total ON/OFF Time [+4]
71

menu up 5 ()

Calculator : Input X =
0

X
가 Y
X

5+7
up down '+'
input 7 input

Note:

6.

Uisoflow-309F 가 가 LCD 가

Uisoflow-309F 가 가 1 가
 가 가 가 “*F” 가
 가 가 가 가
 2 menu 08

6.1 ()

Display at LCD	Cause	Solution
Rom Parity Error	* System ROM	*
Stored Data Error	* System	*
SCPU Fatal Error!	* SCPU	*
Timer Slow Error Timer Fast Error	* System	*
CPU or IRQ Error	* CPU or IRQ	*
System RAM Error	* System RAM	*
Time or Bat Error	* System date time chip error	* 제조사 에게 문의
No Display, Irratic or Abnormal Operation	*	*
Stroke Key - No Response	*	* 가

7.

UISOflow-309F

RS-232C

FUJI

7.1

Pin	1		, +	()
	2	RXD			
	3	TXD			
	4				
	5	GND			
	6	PULSE			
	7				
	8		, -	()
	9				RING

7.2

ASCII (CR), (LF)

		Data Format
DQD(CR)	/ (ex:+0.000000E+00m ³ /d)	±d.dddddE±dd(CR)(LF)*
DQH(CR)	/ (ex:+0.000000E+00m ³ /h)	±d.dddddE±dd(CR)(LF)*
DQM(CR)	/ (ex:+0.000000E+00m ³ /m)	±d.dddddE±dd(CR)(LF)*
DQS(CR)	/ (ex:+0.000000E+00m ³ /s)	±d.dddddE±dd(CR)(LF)*
DV(CR)	(ex:+0.000000E+00m/s)	±d.dddddE±dd(CR)(LF)*
DI+(CR)	(ex:+0000000E+00m ³)	±d.dddddE±d(CR)(LF)**
DI-(CR)	(ex:-0000000E+00m ³)	±d.dddddE±d(CR)(LF)
DIN(CR)	(ex:+0000000E+00m ³)	±d.dddddE±d(CR)(LF)
DID(CR)	(ID) (ex:00000)	dddd(CR)(LF)
DL(CR)	(ex:UP=00.0 DN=00.0 Q=00)	UP=dd.d,DN=dd.d,Q=dd(CR)(LF)
DT(CR)	(ex:08-01-16,10:18:51)	yy-mm-dd hh:mm:ss(CR)(LF)
M@(CR)***		
LCD(CR)		
FOddd(CR)	FO ddd Hz	

Command	Function	Data Format
ESN(CR)	ESN (ex:07005900F)	Dddddddd(CR)(LF)
RING(CR)	MODEM	
OK(CR)	GSM	No action
GA	GSM	Please contact factory for detail
GB	GSM	
GC	GSM	
DUMP(CR)		In ASCII string format
DUMP0(CR)		In ASCII string format
DUMP1(CR)		In ASCII string format,24KB in length
W	IDN 00~255	
N	IDN 00~255	
P		
&	6 가	

Note * : CR LF
 ** : "d" 0~9
 *** : @ 30 "0"

7.3

7.3.1 Prefix P (P)

P 가
 CRC check 2
 DI+(CR) , DI+(CR) +1234567E+0m³
 (CR)(LF)(hexadecimal 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H,20H, 0DH, 0AH), PDI(CR) +1234567E+0m3!F7(CR)(LF) , '!'
 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H
 "!" (20H)가

7.3.2 Prefix W (W)

W W + IDN+
 0 65534 13(0DH), 10 (0AH), 42(2AH,*), 38(26H, & 가
 , IDN=12345 W12345DV(CR)

7.3.3 Prefix N (N)

N IDN

7.3.4 &

& IDN=4321 6 3 (1) (2) (3)
 W4321DQD&DV&DI+(CR)
 : +1.234567E+12m3/d(CR)
 +3.1235926E+00m/s(CR)
 +1234567E+0m3(CR)

7.4 Code for the Keypad

가
가
가
가

Key	Hexadecimal Key Code	Decimal Key Code	ASCII Code	Key	Hexadecimal Key Code	Decimal Key Code	ASCII Code
0	30H	48	0	8	38H	56	8
1	31H	49	1	9	39H	57	9
2	32H	50	2	.	3AH	58	:
3	33H	51	3	clear	3BH,0BH	59	;
4	34H	52	4	menu	3CH,0CH	60	<
5	35H	53	5	enter input	3DH,0DH	61	=
6	36H	54	6	up	3EH	62	>
7	37H	55	7	down	3FH	63	?

8.

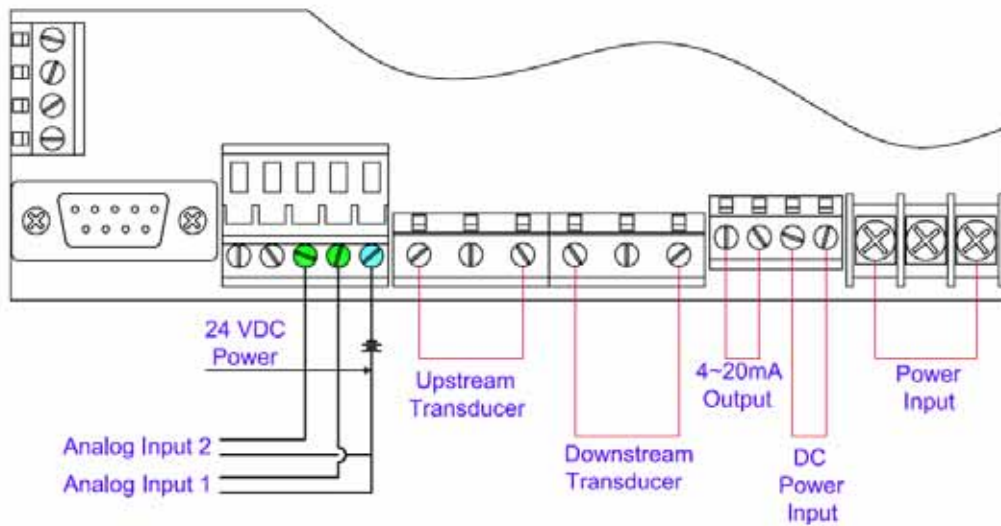
*Uiso*flow-309F

AI1 AI2 4~20mA 0~20mA

8.1

AI1, AI2

, *Uiso*flow-309F 4~20mA . ()



*Uiso*flow-309F 가

1: Energy (caloric quantity) = Flow Value × Difference in Temperature × Specific Heat

() = X X

Note:

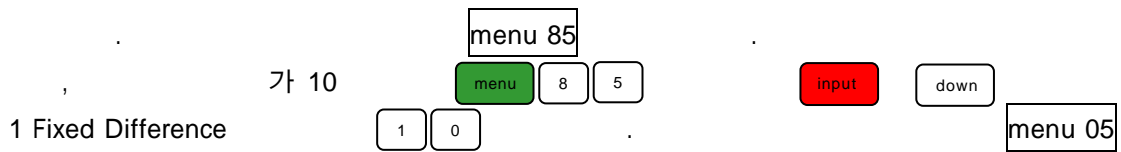
menu 84

: AI1, AI2 ()
 : 86 , 0.0041868GJ/M3.

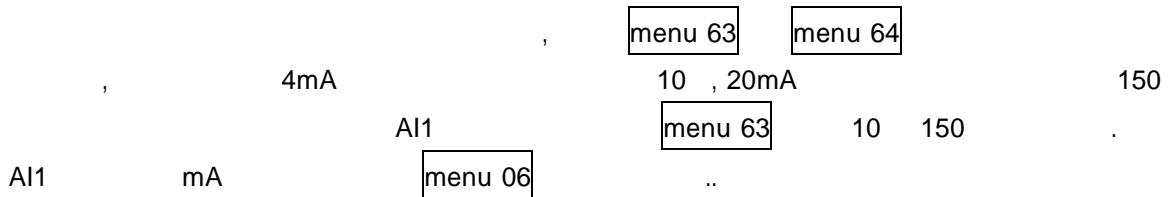
2: Energy (caloric quantity) = Flow Value × Difference in Energy AI1 and Energy AI2
 () = X AI1 AI2

(Instantaneous Caloric/Totalized Caloric)

menu 05



8.3



menu

- menu 05 :
- menu 06 :
- menu 63 : AI1 4mA 20mA
- menu 64 : AI2 4mA 20mA
- menu 85 :
- menu 86 :
- menu 87 :
- menu 88 :
- menu 89 :

9.

9.1

Cameron Hydraulic Data Book (17th ed., Ingersoll-Rand 1988) Table of Physical and Chemical Constants (13th ed., Longmans, 1966)

가

2~5

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt	
Acetaldehyde	CH ₃ CHO	16.1	--	61	--	0.305	
		20	--	68	--	0.295	
Acetic Acid		50	1584	122	5196	--	
	10%	15	--	59	--	1.35	
	50%	15	--	59	--	2.27	
	80%	15	--	59	--	2.85	
	Conc.-glacial	15	--	59	--	1.34	
Acetic anhydride		24	1384	75	4540	--	
		15	--	59	--	0.88	
Acetone		20	1190	68	3903	0.41	
CH ₃ COCH ₃							
Acetylene terabromide		28	1007	82	3303	--	
Acetylene tetrachloride		28	1155	82	3788	--	
Alcohol	allyl	20	--	68	--	1.60	
		40	--	104	--	0.90	
	butyl-n	20	--	68	--	3.64	
		70	--	158	--	1.17	
	Ethyl(grain)	C ₂ H ₅ OH	20	--	68	--	1.52
			37.8	--	100	--	1.2
	Methyl(wood)	CH ₃ OH	15	--	59	--	0.74
			0	--	32	--	1.04
	propyl		20	--	68	--	2.8
			50	--	122	--	1.4
Ammonia		-17.8	--	0	--	0.30	
Amyl Acetate		29.2	1173	85	3847	--	
n-Amyl alcohol		28.6	1224	83	4015	--	
iso-Amyl ether		26	1153	79	3782	--	
Aniline		20	1656	68	5432	4.37	
		10	--	50	--	6.4	
Argon		-183	816.7	-297	2679	--	

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt
Asphalt blended	RC-0, MC-0, SC-0	25	--	77	--	159~324
		37.8	--	100	--	60~108
	RC-1, MC-1, SC-1	37.8	--	100	--	518~1080
		50	--	122	--	159~324
	RC-2, MC-2, SC-2	50	--	122	--	518~1080
		60	--	140	--	215~430
	RC-3, MC-3, SC-3	50	--	122	--	1295~2805
		60	--	140	--	540~1080
	RC-4, MC-4, SC-4	60	--	140	--	1725~4315
		82.8	--	180	--	270~540
	RC-5, MC-5, SC-5	60	--	140	--	6040~18340
		82.8	--	180	--	647~1295
	RS-1, MS-s, SS-1	25	--	77	--	33~216
		37.8	--	100	--	19~75
Asphalt emulsions	Fed # 1	25	--	77	--	215~1510
		37.8	--	100	--	75~367
	Fed # 2 V, VI					
Automotive Crankcase Oils	SAE-5W	-17.8	--	0	--	1295 max
	SAE-10W	-17.8	--	0	--	1295~2590
	SAE-20W	-17.8	--	0	--	2590~10350
	SAE-20	98.9	--	210	--	5.7~9.6
	SAE-30	98.9	--	210	--	9.6~12.9
	SAE-40	98.9	--	210	--	12.9~16.8
	SAE-50	98.9	--	210	--	16.8~22.7
Automotive Gear Oil	SAE-75W	98.9	--	210	--	4.2 min
	SAE-80W	98.9	--	210	--	7.0 min
	SAE-85W	98.9	--	210	--	11.0 min
	SAE-90	98.9	--	210	--	14~25
	SAE-14Q	98.9	--	210	--	25~43
	SAE-150	98.9	--	210	--	43 min
Beer	20	--	68	--	1.8	
Benzene (Benzol) C ₆ H ₆	20	1321	68	4333	0.744	
	0	--	32	--	1.0	
Benzophenone	100	1316	212	4316	--	
Bismuth	285	1663	545	5455	--	
Bone oil	54.4	--	130	--	47.5	
	100	--	212	--	11.6	
Bromine	20	--	68	--	0.34	
Bromobenzene	50	1074	122	3523	--	
Bromoform	25	908	77	2978	--	
Butane-n	-1.1	--	-50	--	0.52	
	--	--	30	--	0.35	
Butyl acetate	30	1172	86	3844	--	
n-Butyl alcohol	20	1257.7	68	4125	--	

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt	
Iso-Butyl bromide		-104	1450	-155	4756	--	
Butyric acid n		20	--	68	--	1.61	
		0	--	32	--	2.3 cp	
Cadmium		360	2150	680	7052	--	
Caesium		130	967	266	3172	--	
Calcium chloride	5 %	18.3	--	65	--	1.156	
	25 %	15.6	--	60	--	4.0	
Carbolic acid (phenol)		18.3	--	65	--	11.83	
Carbon tetrachloride CCl ₄		20	--	68	--	0.612	
		37.8	--	100	--	0.53	
Carbon disulphide CS ₂		25	1149	77	3769	--	
		0	--	32	--	0.33	
		20	--	68	--	0.298	
Carbone tetrachloride		20	938	68	3077	--	
Castor oil		18.6	1500	65	4920	--	
		37.8	--	100	--	259~325	
		54.4	--	130	--	98~130	
China wood oil		20.6	--	69	--	308.5	
		37.8	--	100	--	125.5	
Chlorine		20	850	68	2788	--	
m-Chlornirtobenzene		40	1368	104	4487	--	
Chlorobenzene		25	1302	77	4271	--	
Chloroform		20	--	68	--	0.38	
		25	995	77	3264	--	
		60	--	140	--	0.35	
Coconut oil		37.8	--	100	--	29.8~31.6	
		54.4	--	130	--	14.7~15.7	
Cod oil		37.8	--	100	--	32.1	
		54.4	--	130	--	19.4	
Corn oil		54.4	--	130	--	28.7	
		100	--	212	--	8.6	
Corn starch solutions	22 Baume	21.1	--	70	--	32.1	
		37.8	--	100	--	27.5	
	24 Baume	21.1	--	70		129.8	
		37.8	--	100		95.2	
	25 Baume	21.1	--	70		303	
		37.8	--	100		173.2	
Cotton seed oil		37.8	--	100	--	37.9	
		54.4	--	130	--	20.6	
Crude Oil		48° API	15.6	--	60	--	3.8
			54.4	--	130	--	1.6
		40° API	15.6	--	60		9.7
			54.4	--	130		3.5
		35.6° API	15.6	--	60		17.8
			54.4	--	130		4.9

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt	
Crude Oil	32.6° API	15.6	--	60		23.2	
		54.4	--	130		7.1	
	Salt Creek	15.6	--	60		77	
		54.4	--	130		6.1	
Cyclohexane		20	1278	68	4192	--	
Cyclohexanol		30	1622	86	5320	--	
Decane-n		-17.8	--	0	--	2.36	
		37.8	--	100	--	1.001	
I-Decene		20	1250	68	4100	--	
Deuterium oxide		20	1381	68	4530	--	
Diesel Fuel oils	2D	37.8	--	100	--	2~6	
		54.4	--	130	--	1~3.97	
	3D	37.8	--	100	--	6~11.75	
		54.4	--	130	--	3.97~6.78	
	4D	37.8	--	100	--	29.8 max	
		54.4	--	130	--	13.1 max	
	5D	50	--	122	--	86.6 max	
		71.1	--	160	--	35.2 max	
	Diethyl Ether		20	--	68	--	0.32
	Diethylene glycol		21.1	--	70	--	32
30			1533	86	5028	--	
Diethylene glycol monoethyl ether		30	1296	86	4251	--	
Dimethyl siloxane (Dow Corning 200 fluid)		20	912.3	68	2992	--	
Diphenyl		100	1271	212	4169	--	
Diphenyl ether		30	1462	86	4795	--	
Ethanol		20	1156	68	3792	--	
Ethanol amide		25	1724	77	5655	--	
Ether (diethyl)		25	985	77	3231	--	
Ethyl acetate	CH ₃ COOC ₂ H ₅	15	--	59	--	0.4	
		20	1133	68	3716	0.49	
Ethyl alcohol		20	1161.8	68	3811	--	
Ethyl bromide	C ₂ H ₅ Br	10	932	50	3057	--	
		20	--	68	--	0.27	
Ethyl glycol		30	1606	86	5268	--	
Ethyl iodide		20	876	68	2873	--	
Ethylene bromide		20	--	68	--	0.787	
Ethylene chloride		20	--	68	--	0.668	
Ethylene dibromide		24	1014	75	3326	--	
Ethylene dichloride		23	1240	73	4067	--	
Ethylene glycol		21.1	--	70	--	17.8	
		30	1616	86	5300	--	
Ethylene glycol monoethyl ether		30	1279	86	4195	--	
Ethylene glycol monomethyl ether		30	1339	86	4392	--	
Formaldehyde		25	1587	77	5205	--	
Formamide		25	1610	77	5281	--	

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt
Formic Acid		20	1299	68	4261	--
	10%	20	--	68	--	1.04
	50%	20	--	68	--	1.2
	80%	20	--	68	--	1.4
	Conc.	20	--	68	--	1.48
Freon	-11	21.1	--	70	--	0.21
	-12	21.1	--	70	--	0.27
	-21	21.1	--	70	--	1.45
Fuel Oils	1	21.1	--	70	--	2.39~4.28
		37.8	--	100	--	2.69
	2	21.1	--	70	--	3.0~7.4
		37.8	--	100	--	2.11~4.28
	3	21.1	--	70	--	2.69~5.84
		37.8	--	100	--	2.06~3.97
	5A	21.1	--	70	--	7.4~26.4
		27.8	--	100	--	4.91~13.7
	5B	21.1	--	70	--	26.4
		37.8	--	100	--	13.6~67.1
	6	50	--	122	--	97.4~660
		71.1	--	160	--	37.5~172
Gallium		50	2740	122	8987	--
Gas oils		21.1	--	70	--	13.9
		37.8	--	100	--	7.4
Gasolines	a	15.6	--	60	--	0.88
		37.8	--	100	--	0.71
	b	15.6	--	60	--	0.64
		37.8	--	100	--	0.40
c	15.6	--	60	--	0.46	
	37.8	--	100	--	0.40	
Glycerin		30	1923	86	6307	--
	100 %	20.3	--	69	--	648
		37.8	--	100	--	176
	50% Water	20	--	68	--	5.29
		60	--	140	--	1.85cp
Glucose		37.8	--	100	--	7.7M~22M
		65.6	--	150	--	880~2420
Guaicol		100	1252	212	4107	--
Helium		-268.8	179.8	-452	590	--
n-Heptane		-17.8	--	0	--	0.928
		22.4	1150	72	3772	--
		37.8	--	100	--	0.511
Heptane		30	1082	86	3549	--
Heptyne		30	1159	86	3802	--
Hexane		20	1203	68	3946	--
n-Hexane		-17.8	--	0	--	0.683
		21.2	1085	70	3559	--

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt
n-Hexane		37.8	--	100	--	0.401
Honey		37.8	--	100	--	73.6
Hydrogen		-256	1187	-429	3893	--
Industrial Lubricants Turbine Oils	685	15.6	--	60	--	647
	SSU at 100	93.3	--	200	--	14.5
	420	15.6	--	60	--	367
	SSU	93.3	--	200	--	11
	315	15.6	--	60	--	259
	SSU	93.3	--	200	--	9
	215	15.6	--	60	--	151
	SSU	93.3	--	200	--	7.3
	150	15.6	--	60	--	99
SSU	93.3	--	200	--	6	
Machine Lubricants	# 8	37.8	--	100	--	23~34
		54.4	--	130	--	13~18
	# 10	37.8	--	100	--	37~72
		54.4	--	130	--	18~25
	# 20	37.8	--	100	--	72~83
		54.4	--	130	--	25~39
# 30	37.8	--	100	--	75~119	
	54.4	--	130	--	39~55	
Cutting Oil	# 1	37.8	--	100	--	30~40
		54.4	--	130	--	17~23
	# 2	37.8	--	100	--	40~46
		54.4	--	130	--	23~26
Indium		260	2215	500	7265	--
Ink Printers		37.8	--	100	--	550~2200
		54.4	--	130	--	238~660
Insulating oil		21.1	--	70	--	24.1 max
		37.8	--	100	--	11.75 max
Kerosene		20	--	68	--	2.71
		25	1315	77	4313	--
Jet Fuel(av)		-34.4	--	-30	--	7.9
Lard		37.8	--	100	--	62.1
		54.4	--	130	--	34.3
Lard oil		37.8	--	100	--	41~47.5
		54.4	--	130	--	23.4~27.1
Lead		340	1760	644	5773	--
Linseed oil		37.8	--	100	--	30.5
		54.4	--	130	--	18394
Menhaden oil		37.8	--	100	--	29.8
		54.4	--	130	--	18.2
Menthol		50	1271	122	4169	--
Merck		20.2	1482.3	68	4862	--
Mercury		20	1454	68	4769	-

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt
Mercury		21.1	--	70	--	0.118
		37.8	--	100	--	0.11
Methanol		20	1118	68	3667	--
Methyl acetate		20	--	68	--	0.44
		30	1131	86	3710	--
Methyl alcohol		20	1121.2	68	3678	--
Methyl bromide		2	905	36	2968	--
Methyl iodide		30	--	68	--	0.213
		30	815	--	2673	--
Methylene bromide		24	971.2	--	3186	--
Methylene chloride		23.5	1064	74	3490	--
Methylene iodide		24	977.7	75	3207	--
Milk		20	--	68	--	1.13
Molasses	a. first	37.8	--	100	--	281~5070
		54.4	--	130	--	151~1760
	b. second	37.8	--	100	--	1410~13.2M
		54.4	--	130	--	660~3.3M
	c. Blackstrap	37.8	--	100	--	2630~55M
		54.4	--	130	--	1320~16.5M
Naphthalene		80	--	176	--	0.9
Naphtha		25	1225	77	4018	--
Neats foot oil		37.8	--	100	--	49.7
		54.4	--	130	--	27.5
Nitrobenzene		20	--	68	--	1.67
		23.8	1462	75	4795	--
Nitrogen		-188.9	744.7	-308	2443	--
Nonane		20	1248	68	4093	--
i-nonane		20	1218	68	3995	--
Nonene-n		-17.8	--	0	--	1.728
		37.8	--	100	--	0.807
n-Pulseane		-17.8	--	0	--	1.266
		20	1192	68	3910	--
		37.8	--	100	--	0.645
Oil (lubricating)		10	1625	50	5330	--
Oil of camphor		25	1390	77	4559	--
Oleic acid		20	1442	68	4730	--
Olive oil		21.7	1440	71	4723	--
		37.8	--	100	--	43.2
		54.4	--	130	--	24.1
Oxygen		-182.9	912	-297	2991	--
Palm oil		37.8	--	100	--	42
		54.4	--	130	--	26.4
Paraldehyde		28	1197	82	3926	--
Peanut oil		37.8	--	100	--	42
		54.4	-	130	--	23.4

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt		
l-pentadecene		20	1351	68	4431	--		
Pentane		20	1008	68	3306	--		
iso-pentane		25	985	77	3231	--		
n-pentane		-17.8	--	0	--	0.508		
		20	1044	68	3424	--		
		26.7	--	80	--	0.342		
Petrolatum		54.5	--	130	--	20.5		
		71.1	--	160	--	15		
Phenol		100	1274	212	4179	--		
Potassium		150	1840	302	6035	--		
n-propanol		20	1220	68	4002	--		
Propionic acid		20	--	68	--	1.13		
n-Propyl acetate		26	1182	79	3877	--		
n-Propyl alcohol		20	1223.2	68	4012	--		
Propylene glycol		21.1	--	70	--	52		
Pyridine		20	1445	68	4740	--		
Quenching oil (typical)		--	--	--	--	10~200		
Rapeseed oil		37.8	--	100	--	54.1		
		54.4	--	130	--	31		
Rosin oil		37.8	--	100	--	324.7		
		54.4	--	130	--	129.9		
Rosin (wood)		37.8	--	100	--	216~11M		
		93.3	--	200	--	108~4400		
Rubidium		160	1260	320	4133	--		
Sesame seed oil		37.8	--	100	--	39.6		
		54.4	--	130	--	23		
Silicone tetrachloride		30	766.2	86	2513	--		
Sodium		150	2500	302	8200	--		
Sodium Chloride (fused)		850	1991	1562	6530	--		
		5 %	20	--	68	--	1.097	
		25 %	15.6	--	60	--	2.4	
Sodium hydroxide (caustic soda)		20 %	18.3	--	65	--	4.0	
		30 %	18.3	--	65	--	10.0	
Soya bean oil		37.8	--	100	--	35.4		
		54.4	--	130	--	19.64		
Sperm oil		37.8	--	100	--	21~23		
		54.4	--	130	--	15.2		
Sugar solution corn syrup		86.4 Brix		37.8	--	100	--	180Mcp
				82.2	--	180	--	1750cp
		84.4 Brix		37.8	--	100	--	48Mcp
				82.2	--	180	--	800cp
		82.3 Brix		37.8	--	100	--	17Mcp
				82.2	--	180	--	380cp
80.3 Brix		37.8	--	100	--	6900cp		
		82.2	--	180	--	230cp		

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt	
Sugar solution corn syrup	78.4 Brix	37.8	--	100	--	3200cp	
		82.2	--	180	--	160cp	
Sugar solution Sucrose	60 Brix	21.1	--	70	--	49.7	
		37.8	--	100	--	18.7	
	64 Brix	21.1	--	70	--	95.2	
		37.8	--	100	--	31.6	
	68 Brix	21.1	--	70	--	216.4	
		37.8	--	100	--	59.5	
	72 Brix	21.1	--	70	--	595	
		37.8	--	100	--	138.6	
	74 Brix	21.1	--	70	--	1210	
		37.8	--	100	--	238	
	76 Brix	21.1	--	70	--	2200	
		37.8	--	100	--	440	
	Sulphur		130	1332	266	4369	--
	Sulphuric acid	100%	20	--	68	--	14.6
95%		20	--	68	--	14.5	
60%		20	--	68	--	4.4	
Tar, coke oven		21.1	--	70	--	600~1760	
		37.8	--	100	--	141~308	
Tar, gas house		21.1	--	70	--	3300~66M	
		37.8	--	100	--	440~4400	
Tar, pine		37.8	--	100	--	559	
		55.6	--	132	--	108.2	
Tar, road	RT-2	50	--	122	--	43.2~64.9	
		100	--	212	--	8.88~10.2	
	RT-4	50	--	122	--	86.6~154	
		100	--	212	--	11.6~14.3	
	RT-6	50	--	122	--	216~440	
		100	--	212	--	16.8~26.2	
	RT-8	50	--	122	--	660~1760	
		100	--	212	--	31.8~48.3	
	RT-10	50	--	122	--	4.4M~13.2M	
		100	--	212	--	53.7~86.6	
	TR-12	50	--	122	--	25M~75M	
		100	--	212	--	108~173	
Tetralin		20	1482	68	4868	--	
Tin (molten)		240	2470	464	8102	--	
Toluene		20	--	68	--	0.68	
		30	1275	86	4182	--	
o-Toluidine		22.5	1669	73	5474	--	
l-tridecene		20	1313	68	4307	--	
Tri ethylene glycol		21.1	--	70	--	40	
Tri ethylamine		0	1189	32	3900	--	
Turpentine		25	1225	77	4018	--	

Liquid		t ()	c (m/s)	t ()	c (ft/s)	cSt
Turpentine		37.8	--	100	--	86.6~95.2
		54.4	--	130	--	39.9~44.3
l-Undecene		20	1275	68	4182	--
Varnish, spar		20	--	68	--	313
		37.8	--	100	--	143
Water	Distilled	20	1482.9	68	4864	1.0038
	Fresh	15.6	--	60	--	1.13
		54.4	--	130	--	0.53
	Sea	--	--	--	--	1.15
Water (sea) (surface,3.5% salinity)		15	1507.4	59	4944	--
Whale oil		37.8	--	100	--	35~39.6
		54.4	--	130	--	19.9~23.4
Xylene hexafluoride		25	879	77	2883	--
o-Xylene		20	--	68	--	0.93
		22	1352	72	4435	--
Zinc		450	2700	842	8856	--

9.2

()

Pipe Material	Sound Velocity(m/s)	Liner Material	Sound Velocity(m/s)
Steel	3206	PTFE	1225
ABS	2286	Titanium	3150
Aluminum	3048	Cement	4190
Brass	2270	Bitumen	2540
Cast Iron	2460	Porcelain enamel	2540
Bronze	2270	Glass	5970
Fiber glass-epoxy	3430	Plastic	2280
Glass	3276	Polyethylene	1600
Polyethylene	1950	PTFE	1450
PVC	2540	Rubber	1600

9.3

(at 1 atm : : m/sec)

t()	v(m/sec)	t()	v(m/sec)	t()	v(m/sec)	t()	v(m/sec)
0	1402.3	25	1496.6	50	1542.5	75	1555.1
1	1407.3	26	1499.2	51	1543.5	76	1555.0
2	1412.2	27	1501.8	52	1544.6	77	1554.9
3	1416.9	28	1504.3	53	1545.5	78	1554.8
4	1421.6	29	1506.7	54	1546.4	79	1554.6
5	1426.1	30	1509.0	55	1547.3	80	1554.4
6	1430.5	31	1511.3	56	1548.1	81	1554.2
7	1434.8	32	1513.5	57	1548.9	82	1553.9
8	1439.1	33	1515.7	58	1549.6	83	1553.6
9	1443.2	34	1517.7	59	1550.3	84	1553.2
10	1447.2	35	1519.7	60	1550.9	85	1552.8
11	1451.1	36	1521.7	61	1551.5	86	1552.4
12	1454.9	37	1523.5	62	1552.0	87	1552.0
13	1458.7	38	1525.3	63	1552.5	88	1551.5
14	1462.3	39	1527.1	64	1553.0	89	1551.0
15	1465.8	40	1528.8	65	1553.4	90	1550.4
16	1469.3	41	1530.4	66	1553.7	91	1549.8
17	1472.7	42	1532.0	67	1554.0	92	1549.2
18	1476.0	43	1533.5	68	1554.3	93	1548.5
19	1479.1	44	1534.9	69	1554.5	94	1547.5
20	1482.3	45	1536.3	70	1554.7	95	1547.1
21	1485.3	46	1537.7	71	1554.9	96	1546.3
22	1488.2	47	1538.9	72	1555.0	97	1545.6
23	1491.1	48	1540.2	73	1555.0	98	1544.7
24	1493.9	49	1541.3	74	1555.1	99	1543.9

9.4



가 가 가 가

9.4.1 & &

Size		Carbon Steel (KS D3576 / JIS G3459)						Stainless Steel								Copper Pipe								
		KS(S.O.P)		SCH 20		SCH 40		SCH 5		SCH10		SCH20		SCH40		K type		L type		M type				
mm	Inch	O.D	t	I.D	t	I.D	t	I.D	O.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D			
10	3/8	17.3	2.3	12.7	-	-	2.3	12.7	17.3	1.20	14.9	1.65	14.0	2.0	13.3	2.31	12.7	12.70	1.24	10.22	0.89	10.92	0.64	11.42
15	1/2	21.7	2.8	16.1	-	-	2.8	16.1	21.7	1.65	18.4	2.11	17.48	2.5	16.7	2.77	16.2	15.9	1.24	13.4	1.02	13.84	0.71	14.46
20	3/4	27.2	2.8	21.6	-	-	2.9	21.4	27.2	1.65	23.9	2.11	23.0	2.5	22.2	2.87	21.5	22.2	1.65	18.92	1.14	19.94	0.81	20.6
25	1	34.0	3.2	27.6	-	-	3.4	27.2	34.0	1.65	30.7	2.77	28.5	3.0	28.0	3.38	27.2	28.6	1.65	25.26	1.27	26.04	0.89	26.6
32	1 1/4	42.7	3.5	35.7	-	-	3.6	35.5	42.7	1.65	39.4	2.77	37.2	3.0	36.7	3.58	35.5	34.9	1.65	31.62	1.40	32.12	1.07	32.78
40	1 1/2	48.6	3.5	41.6	-	-	3.7	41.2	48.6	1.65	45.3	2.77	43.1	3.0	42.6	3.68	41.2	41.3	1.83	37.62	1.52	38.24	1.24	38.8
50	2	60.5	3.8	52.9	3.2	54.1	3.9	52.7	60.5	1.65	57.2	2.77	55.0	3.5	53.5	3.91	52.7	54	2.11	49.76	1.78	50.42	1.47	51.04
65	2 1/2	76.3	4.2	67.9	4.5	67.3	5.2	65.9	76.3	2.11	72.1	3.05	70.2	3.5	69.3	5.16	66.0	66.7	2.41	61.86	2.03	62.62	1.65	63.38
80	3	89.1	4.2	80.7	4.5	80.1	5.5	78.1	89.1	2.11	84.9	3.05	83.0	4.0	81.1	5.49	78.1	79.4	2.77	73.84	2.29	74.8	1.83	75.72
90	3 1/2	102	4.2	93.2	4.5	92.6	5.7	90.2	102	2.11	97.4	3.05	95.5	4.0	93.6	5.74	90.1	-	-	-	-	-	-	-
100	4	114	4.5	105.3	4.9	104.5	6.0	102.3	114	2.11	110.1	3.05	108.2	4.0	106.3	6.02	102.3	105	3.4	97.98	2.79	99.2	2.41	99.96
125	5	140	4.5	130.8	5.1	129.6	6.6	126.8	140	2.77	134.3	3.40	133.0	5.0	129.8	6.55	126.7	130	4.06	122.1	3.18	123.8	2.77	124.6
150	6	165	5.0	155.2	5.5	154.2	7.1	151.0	165	2.77	159.7	3.76	157.7	5.0	155.2	7.11	151.0	156	4.88	145.8	3.56	148.5	3.10	149.4
200	8	217	5.8	204.9	6.4	203.7	8.2	200.1	217	2.77	211.0	4.19	208.1	6.5	203.5	8.18	200.1	206	6.88	192.6	5.08	196.2	4.32	197.7
250	10	267	6.6	254.2	6.4	254.6	9.3	248.8	267	2.77	261.9	4.57	258.3	6.5	254.4	9.27	248.9	257	8.59	240.0	6.35	244.5	5.38	246.4
300	12	319	6.9	304.7	6.4	305.7	10.3	297.9	319	3.40	311.7	4.78	308.9	6.5	305.5	9.52	299.5	-	-	-	-	-	-	-
350	14	356	7.9	339.8	7.9	339.8	11.1	333.4	356	3.96	347.7	4.78	346.0	6.35	342.9	9.52	336.6	-	-	-	-	-	-	-
400	16	406	7.9	390.6	7.9	390.6	12.7	381.0	406	3.96	398.6	4.78	396.8	6.35	393.7	9.52	387.4	-	-	-	-	-	-	-
450	18	457	7.9	441.4	7.9	441.4	14.3	428.6	457	4.78	447.6	4.78	447.6	6.35	444.5	9.52	438.2	-	-	-	-	-	-	-
500	20	508.0	7.9	492.2	9.5	489.0	15.1	477.8	508.0	4.78	498.4	5.54	496.9	6.35	493.3	9.52	489.0	-	-	-	-	-	-	-
550	22	589	-	-	9.5	569.8	-	-	589	4.78	579.2	5.54	577.7	6.35	576.1	9.52	569.8	-	-	-	-	-	-	-
600	24	610	-	-	9.5	590.6	-	-	610	4.78	600.0	6.35	596.9	6.35	596.9	9.52	590.6	-	-	-	-	-	-	-

9.4.2 PVC & PVC Schedule & PP-HP & PVDF

Size		PVC PIPE						PVC SCHEDULE PIPE						PP-HP PIPE				PVDF-HP PIPE								
		VP		VG1		VG2		SCH 40		SCH80		SCH120		PN 6		PN 10		PN10		PN16						
A	O.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D	t	I.D					
16	22	3.0	16.0	2.7	16.6	-	-	1	33.4	3.38	26.64	4.55	24.3	5.1	23.24	1/4	20	1.8	16.4	2.5	15	-	-	1.9	16.2	
20	26	3.0	20.0	2.7	20.6	-	-	1 1/4	42.2	3.56	35.08	4.86	32.6	5.46	31.28	3/4	26	1.8	21.4	2.7	19.6	-	-	1.9	21.2	
26	32	3.5	26.0	3.1	25.8	-	-	1 1/2	48.3	3.68	40.94	5.08	38.1	5.72	36.86	1	32	1.9	28.2	3	26	-	-	2.4	27.2	
30	38.0	3.5	31.0	3.1	31.8	-	-	2	60.3	3.91	52.48	5.54	49.2	6.4	47.6	1 1/4	40	2.3	35.4	3.7	32.6	-	-	2.4	35.2	
36	42	-	-	3.1	35.8	1.8	38.4	2 1/2	78.0	5.16	62.68	7.01	59.0	7.8	57.76	1 1/2	50	2.9	44.2	4.60	40.8	-	-	3	44	
40	48	4.0	40.0	3.6	40.8	1.8	44.4	3	88.9	5.49	77.92	7.62	73.7	8.9	71.12	2	63	3.6	55.8	5.8	51.4	2.5	58	3	57	
60	60	4.6	61.0	4.1	61.8	1.8	66.4	3 1/2	102	6.74	90.12	8.08	85.4	11.1	79.4	2 1/2	76	4.3	66.4	6.9	61.2	2.5	70	3.6	67.8	
65	76	5.2	65.6	4.1	67.8	2.2	71.6	4	114	6.02	102.3	8.56	97.2	12.7	89.9	3	90	5.1	79.8	8.2	73.6	2.8	84.4	4.3	81.4	
75	89	5.9	77.2	5.5	78.0	2.7	83.6	5	141	6.55	128.2	9.52	122.3	14.3	112.8	4	110	6.3	97.4	10.0	90.0	3.4	103.2	5.3	99.4	
100	114	7.1	99.8	6.6	100.8	3.1	107.8	6	168	7.11	154.1	10.97	146.4	18.2	131.8	4 1/2	125	7.1	110.8	11.4	102.2	3.9	117.2	6	113	
125	140	8.3	123.4	7.0	126	4.1	131.6	8	219.0	8.18	202.6	12.7	193.6	21.4	176.2	5	140	8.0	124	12.6	114.4	4.3	131.4	6.7	126.6	
150	165	9.6	145.8	8.9	147.2	5.1	154.8	10	274	9.37	255.2	15.06	243.8	25.4	223.1	6	160	9.1	141.8	14.6	130.8	4.9	150.2	7.7	144.6	
200	216	11.1	193.8	10.3	195.4	6.5	203.0	12	324	10.31	303.2	17.45	288.9	-	-	7	180	10.2	159.6	16.4	147.2	5.5	169	8.60	162.8	
250	267	13.4	240.2	12.7	241.6	7.8	251.4	14	358	11.00	333.6	19.05	317.5	-	-	8	200	11.4	177.2	18.2	163.6	6.2	187.6	9.6	180.8	
300	318	16.1	285.8	15.1	287.8	9.2	299.6	16	406	12.70	391.0	21.41	363.6	-	-	9	225	12.8	199.4	20.5	184	6.9	211.2	10.6	203.4	
-	-	-	-	-	-	-	-	18	457	14.27	425.7	23.86	409.5	-	-	10	250	14.2	221.6	22.6	204.4	7.7	234.6	11.9	226.2	
-	-	-	-	-	-	-	-	20	508.0	15.06	477.9	26.19	455.6	-	-	11	280	15.9	248.2	25.5	229	8.6	262.8	13.4	253.2	
-	-	-	-	-	-	-	-	24	610	17.45	574.7	30.94	547.7	-	-	12	315	17.9	279.2	28.7	257.6	9.7	295.6	15	285	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	355	20.1	314.8	32.3	290.4	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	400	22.7	354.6	38.4	327.2	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

9.4.3 PEM & Ductile Iron

Ductile Pipe							
Size A	O.D.	Class 1		Class 2		Class 3	
		t	I.D.	t	I.D.	t	I.D.
80	98	7.4	83.2	6.7	84.6	6	86
100	118	7.5	103.0	6.8	104	6.1	106
125	144	7.6	128.8	6.9	130	6.2	132
150	170	7.7	154.6	7	156	6.3	157
200	222	7.8	206.4	7.1	208	6.4	209
250	274	8.3	257.4	7.5	259	6.8	260
300	326	8.8	308.4	8	310	7.2	312
350	378	9.4	359	8.5	361	7.7	363
400	429	9.9	409	9	411.0	8.1	413
450	480	10.5	459	9.5	461	8.6	463
500	532	11	510	10.0	512	9.0	514
600	635	12.1	611	11	613	9.9	615
700	738	13.2	712	12	714	10.8	716.4
800	842	14.3	813	13	816	11.7	819
900	945	15.4	914	14	917	12.6	920
1000	1048	16.5	1015	15	1018	13.5	1021
1100	1144	17.6	1109	16	1112	14.4	1115
1200	1255	18.7	1218	17	1221	15.3	1224

PEM PIPE							
Size A	O.D.	Normal		Class 1		Class 2	
		t	I.D.	t	I.D.	t	I.D.
16	21.5	2.5	16.5	-	-	-	-
20	27	3.0	21.0	-	-	-	-
25	34	3.5	27.0	-	-	-	-
30	42	4.0	34.0	-	-	-	-
40	48	4.5	39.0	-	-	-	-
50	60	5.5	49.0	-	-	-	-
65	76	6.0	64.0	5.6	64.8	4.9	66.2
75	89	8.1	72.8	6.6	75.8	5.7	77.6
100	114	10.4	93.2	8.4	97.2	7.4	99.2
125	140	12.7	115	10.4	119	9.0	122
150	165	15.3	134	12.2	141	10.6	144
200	216	19.5	177	16	184	13.9	188
250	267	24.3	218	19.8	227	17.2	232.6
300	318	28.9	260	23.6	271	20.5	277
350	370	33.6	303	27.4	315	23.9	322
400	420	38.2	344	31.1	358	27.1	366
450	457	41.6	374	33.9	389	29.5	398
500	508	46.2	416	37.6	433	32.8	442
550	559	50.8	457	41.4	476	36.1	487
600	610	55.4	499	45.2	519.2	39.3	531