AIGA 2005 Meeting

Recent Developments in Compressed Gas Cylinder Valve Technology

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Major Advances in the 1980's

- The Restrictive Flow Orifice
- Air Actuated Valves
- The DISS Series of Connections
- Diaphragm Seal Enhancements
- Material of Construction Enhancements

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First – A Quick Look Back in Time at 80 Years of Industrial Valves

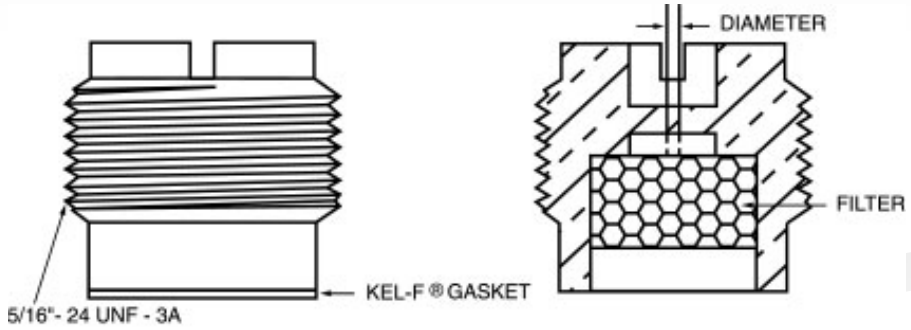
- O Ring Seal Type Valves
- Early Packed Valves
- Diaphragm Packless Valves
- Later Style Packed Valves
- Springless Diaphragm Valves

The Restrictive Flow Orifice

- Concept dates back to 1982 prior to use of gas cabinets
- Pioneering paper written by Matheson Tri Gas and Superior Valve in 1983 presented at SEMI Conference
- First applications were AsH3, PH3, SiH4 and mixtures with pressures @ 2000 psig
- Flow reduced from 20,000 l/min→200 l/min
- Original designs were 0.010 inch with a 2 micron filter and 0.006 inch with a 0.5 micron filter
- Larger orifices used for corrosive gases without filters
- Accepted and used at semiconductor facilities

Restrictive Flow Orifice Schematic

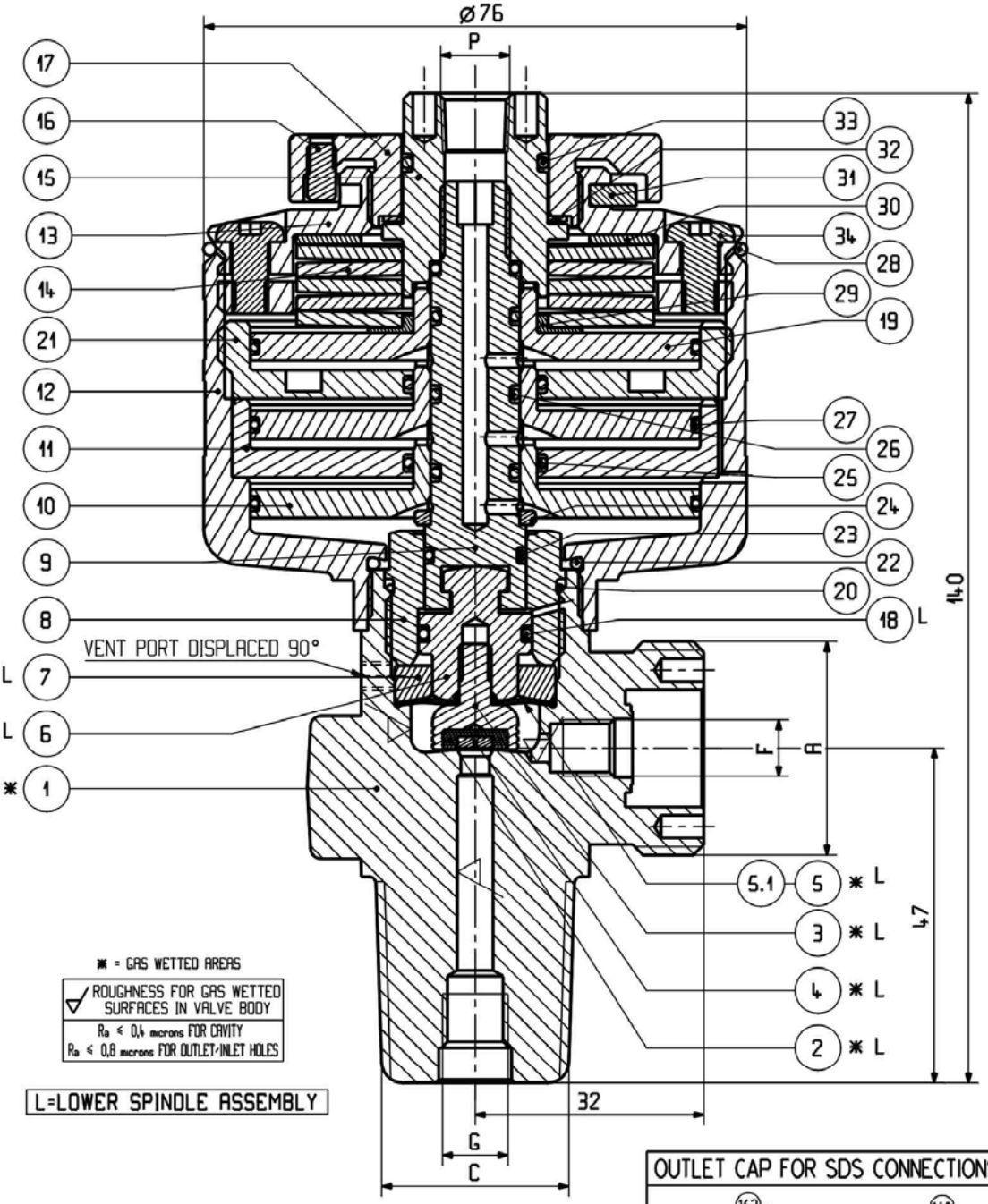
- Schematic



FLOW RESTRICTOR

Air Actuated Valves

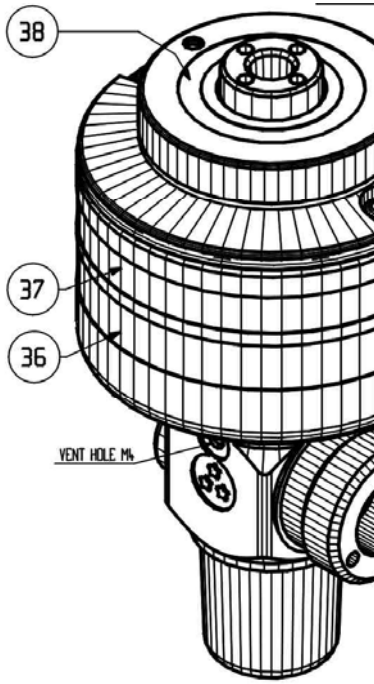
- Design dates back to mid 1980's, prior to widespread use of gas cabinets
- First designs from Superior Valve. Martin Valve, Ceodeux Valve, and other designs followed.
- Actuation pressure originally 150 psig
- Then lowered to 75 psig to utilize plant air or nitrogen
- Suitable for use with diaphragm and packed seal designs
- Usage peaked in the late 1980's in the US
- Uses today focused on electronic grade fills of ton containers



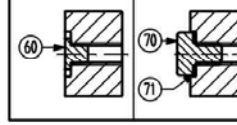
WORKING PRESSURE	200 bar/3000psi	
LEAK RATES	INTERNAL	≤ 1×10^{-8} mbar.l/s
	EXTERNAL	≤ 1×10^{-8} mbar.l/s
	SAFETY	–
ACTUATOR PRESSURE	5–10 BAR 70–140 PSI	
FLOW COEFFICIENT	C_v : 0.35	
SEAT ORIFICE SIZE	4 mm	
TEMPERATURE RANGE	–20° C / +70° C	

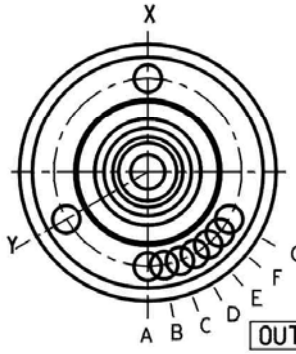
MARKINGS	
TYPE	YES
MATERIAL	YES
MANUFACTURING DATE	MM / JJ
MANUFACTURER LOGO : 3 STARS	☆☆
MANUFACTURER IDENT.–NUMBER	YES
WEIGHT	NO
OUTLET CONNECTION	YES
APROVAL NUMBER	

CONNECTIONS ACC. CUSTOMER SPECIFICATIONS		
C	INLET CONNECTION	
A	OUTLET CONNECTION	SEE TABLE
F	FLOW RESTRICTOR THREAD	5/16"-24UNF
G	DIP TUBE THREAD	
P	PNEUMATIC PORT	1/8"-27NPT
	GAS SERVICE	SEE TABLE



VENT HOLE CAPS





OUTLET CONNECTIONS

GAS SERVICE	HOLES POS.	MARKINGS	ART. NBR.
PHOSPHINE	X+Y+A	SA–A	D38547.00.R001
	X+Y+B		
	X+Y+C		
	X+Y+D		
	X+Y+E		
	X+Y+F		
	X+Y+G		

OUTLET CAP FOR SDS CONNECTIONS

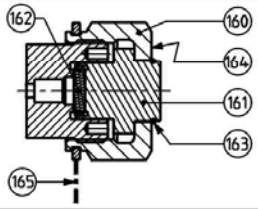


FIG7

Ind	No.Mod.	Modification	Mod.par

Matiere : AISI 316L
W.NR.1.4435
ACCORDING EN 10088-3

Echelle : 3:2
Date : 29.4.99
Dessine : Geoff.P.
Verifie :

Designation : HIGH FLOW CYLI
VALVE, AIR OPERATED, TIED
SEAL TYPE, FOR UHP/SDS GAS

CEODEUX ☆☆ Ultra Pure Equipment Technology S.A.

Art.: SEE TABLE | Mat.Pied

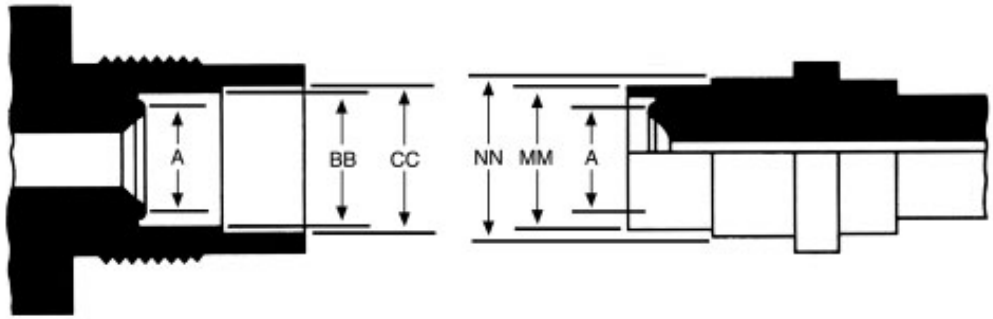
Plan No. : 4-ATMI-

DISS Series of Connections

- Request made to the CGA in mid 1980's
- Connection capable of 1.00x 10-9 ccHe/sec leakrate
- Right Hand Connection capable of 3000 psig
- Originally for hydrides and mixtures used in fabs
- Usage expanded to corrosive & halocarbon gases
- Two series of connections: DISS 630 & 710 in CGA V-1
- Face seal connection
- Multiplicity by varying diameters of outlet & nipple
- Accepted by ISO as an International Standard

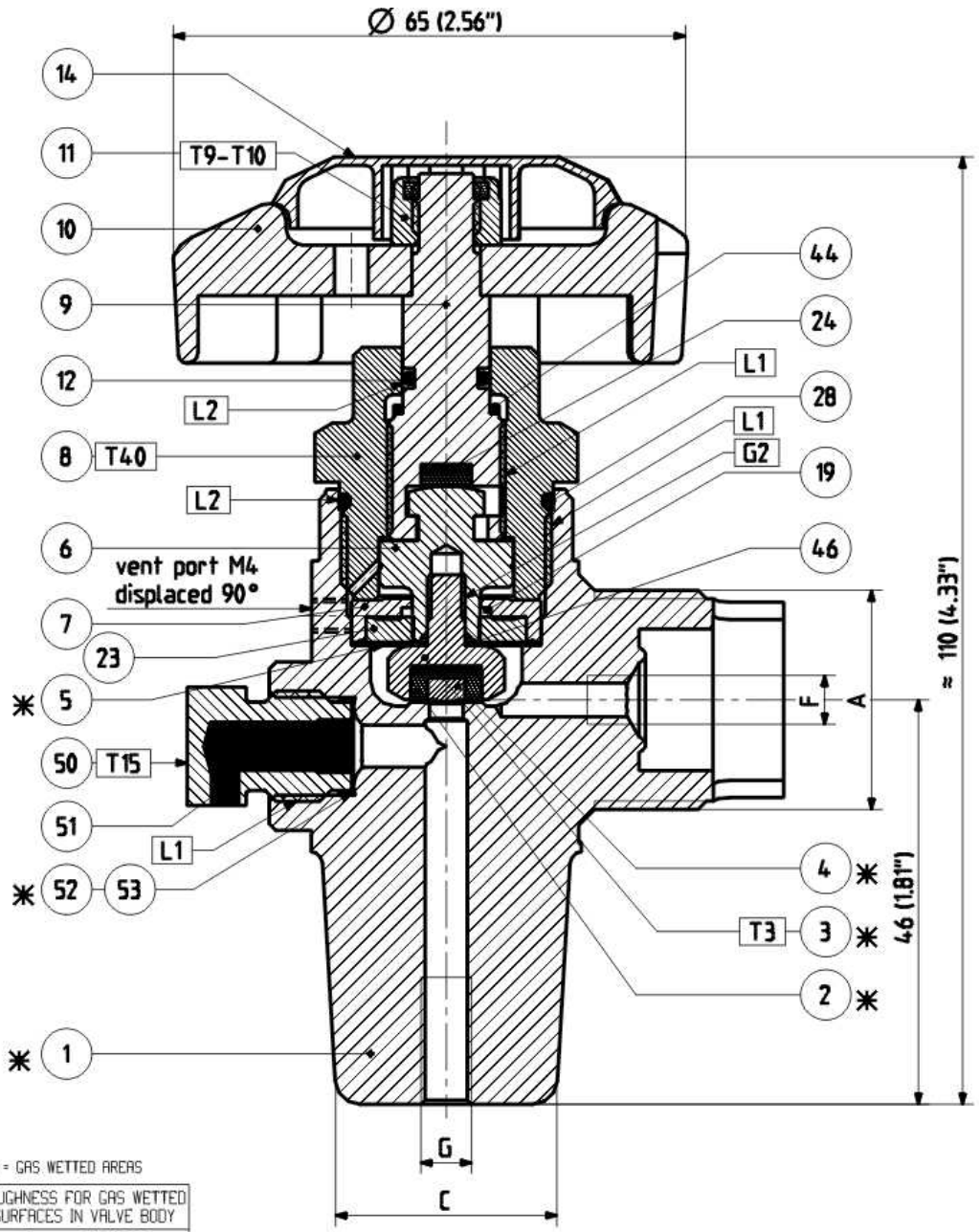
DISS Schematic

- Schematic



Valve Seal Enhancements

- Basic designs – O Ring Seal, Diaphragm, & Packed
- Enhancements needed for semiconductor users
- Need for packed valve with handwheel
- Diaphragm valves without a spring for corrosives
- Springless diaphragm design became available in 1990
- Utilized with both high & low pressure gases
- Suitable for use with corrosive gases as well as hydrides.
- Widely accepted worldwide

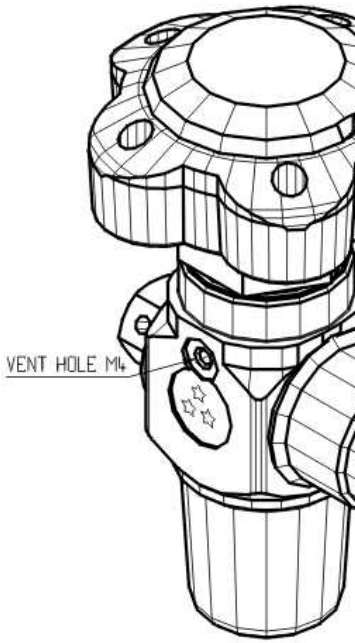


✱ = GAS WETTED AREAS

ROUGHNESS FOR GAS WETTED SURFACES IN VALVE BODY
$R_a \leq 0{,}4$ microns FOR CAVITY
$R_a \leq 0{,}8$ microns FOR OUTLET/INLET HOLES

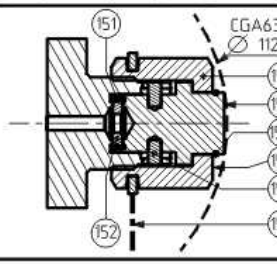
WORKING PRESSURE	200 bar/3000psi	
LEAK RATES (mbar.l/s)	INTERNAL	$\leq 1 \times 10^{-8}$
	EXTERNAL	$\leq 1 \times 10^{-8}$
	SAFETY	$\leq 1 \times 10^{-8}$
OPERATION TORQUE	3-4 Nm / 2.25-3 ft-lbs	
FLOW COEFFICIENT	C_v : 0.25	
SEAT ORIFICE SIZE	4 mm / 0.16 inches	
TEMPERATURE RANGE	-20°C...70°C / -4°F...158°F	

MARKINGS	
TYPE	YES
MATERIAL	YES
MANUFACTURING DATE	MM / JJ
MANUFACTURER LOGO: 3 STARS	☆☆
MANUFACTURER IDENT.-NUMBER	YES
WEIGHT	NO
OUTLET CONNECTION	YES
INLET CONNECTION	YES
SEAT MATERIAL	YES
APROVAL NUMBER	ONLY FOR GERMANY



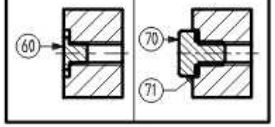
LUBRICANTS NON GAS WETTED PARTS	L1	L2	
THREAD LOCKING	G2		
TORQUES	T3	T40	T15 T9-T10

OUTLET CAP FOR CGA DISS



MATERIALS		STANDARD
AISI 316L	W. Nr. 1.4435	EN 10 088-3
HASTELLOY	W. Nr. 2.4602.40	VdTUV Bl.479

VENT HOLE CAPS



BASIC DESIGN

Ind	No.Mod.	Modification	IF Mod.
a		Drawing updated	

Matiere :

Echelle : 3:2
Date : 5.11.99
Dessine : Geoff.P.
Verifie :

CEODEUX ☆ Ultra Pure Equipment

Designation : HIGH PRESSUR TIED DIAPHRAGM SEAL TYP FOR ULTRA HIGH PURITY G

Art.: | Mat.P

Plan No. :

Material of Construction Enhancements

- 1980's: Brass, Al-Si-Br, 303 SS
- 1990's: Brass, Al-Si-Br, 303SS, 316LSS
- 2000's: Above + Hastelloy & Nickel

Definite trend towards stainless steels and "exotic" metals for corrosive gas services

Two Persistent Problems & Their Solutions

- Seat & Neck Leakers
- Silane Poppers

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Two Persistent Problems & Their Solutions

- **Seat Leaks and Neck Leaks**
  - Torque is critical component in each case
  - Handwheels may need 8-10 ft lbs
  - Outlet caps generally require 35 ft lbs.
  - Check gauging of valve/cylinder threads before valving
  - Do not overuse or overwrap with PTFE tape or lubricant
- **Silane Poppers**
  - Much can be done at the time of filling
  - Double closure of the cylinder valve is important after manifold blowdown
  - Handwheel torque of 8-10 ft lbs is recommended
  - Purge outlet prior to capping off
  - Torque outlet to the recommended torque setting

Relief from Pressure!

- **Pressure Relief Device Requirements vary by National Bodies**
- In US, half of gases require prd's
- In Europe, most gases do not require prd's
- Some Asian requirements are unique
- Trend predicated by philosophy of fire-fighting brigades
- Trend globally is to optionalize the use of prd's to a greater extent
- Points of interest
  - Most gases with LC50<200 ppm do not have prd's
  - When prd's are required, as toxicity or the hazard of the gas increases, the greater will be the desire to contain the gas.
  - Simple asphyxiants utilize an unbacked pressure disc
  - Flammable gases and corrosive gases utilize a pressure disc & a thermal element

Thank You For Your Kind Attention!

- It was a “pressure” to be with you at the 2005 AIGA Technical Seminar!

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