Arrows on the pipelines in the system identify the direction of flow in the pipelines. Labels on the pipelines identify the substances in the pipelines, as follows:

ACID DRAIN	Black text on yellow background
COLD WATER	White text on green background
FUEL GAS	Black text on yellow background
AMBIENT AIR	Black text on green background
NITROGEN	Black text on green background

1.3 Overview of the systems

The TCS, TPU and Kronis systems are designed to treat the hazardous exhaust gases from semiconductor applications such as LPCVD, PECVD, MOCVD and dielectric etch.

Each of the systems uses an inward fired combustor coupled with a three-stage wet scrubber system, to ensure a high destruction rate efficiency together with the effective removal of by-products and the capture of powder deposits, which are removed to acid drain.

The TCS is suitable for all CVD applications and will treat the by-products of NF_3 chamber cleans, but is not suitable for the abatement of PFC gases themselves.

The TPU is suitable for all CVD and many etch applications, particularly those which use PFC perfluorinated compound gas species or ClF_3.

The Kronis is suitable for low K dielectric CVD applications, where precursors such as trimethylsilane $(CH_3)_3SiH$, tetramethylsilane $(CH_3)_4Si$ and dimethyldimethoxysilane $(CH_3O)_2Si(CH_3)_2$ are used. The by-products of PFC species (C_3F_8) and NF_3 chamber clean processes will also be abated.

All of the systems are supplied as an abatement system enclosure (see Section 1.4), together with a WRU (Water Recirculation Unit: see Section 1.5), or a Services Module (see Appendix A8).

You must install and use the WRU or Services Module (as described in this manual), to condition your services supplies to meet the system enclosure requirements, as specified in Section 2.

Three types of each of the abatement systems are available (the E, J and S models), configured for use with European, Japanese and US electrical supplies. Also, your system can be supplied with four inlets, two inlets or a single inlet.

Note that your system may be supplied with a number of ordering options (see Section 1.11). The main part of this manual describes a basic abatement system with a WRU but without other ordering options; refer to Appendices A4 onwards for descriptions of the ordering options.

Note: The TMS (Temperature Management System) ordering option for TCS and TPU systems is described in Appendix A4.

A TMS is supplied fitted as standard to Kronis systems, to prevent the condensation of the precursors or by-products in the Kronis inlet pipelines. The Kronis TMS differs from the TCS and TPU TMS option, and is described in Appendix A5.

1.4 The abatement system enclosure

Refer to Figure 3. The abatement system enclosure has the following major components:

- A combustor (15). During normal system operation (that is, when the bypass valves are on-line: see Section 1.8.4), process gas flows from the pumping systems directly into the combustor, which provides thermal destruction of the gases.
- A three-stage wet scrubber system. The scrubber system consists of the cyclone scrubber (12), the quench/weir (13), and the packed tower (4) which remove the combustion by-products such as HF and SiO_2.

The treated gases then flow into the exhaust gas outlet (1). You will connect the exhaust gas outlet to your exhaust-extraction system.

When a bypass valve is off-line (see Section 1.8.4), the gases from a pumping system do not pass into the combustor but are routed directly to the pumping system bypass outlet. You must configure the bypass outlets as described in Section 3.3.4.

You must provide an electrical supply and nitrogen supplies (for combustor purge and for actuation of valves) to the abatement system enclosure.

On a TPU or Kronis system, you must also provide an oxygen supply to the abatement system enclosure.

You must provide other services supplies for the WRU (see Section 1.5) or Services Module (see Appendix A8).

You must connect the abatement system enclosure to a suitable cabinet-extraction system.

You will connect control signals from your pumping systems and from your Process Tool to the abatement system enclosure (through the interface module: Figure 16, item 9), to identify when a pumping system is on, and to identify when PFC gas is flowing into the abatement system.

1.5 The WRU (Water Recirculation Unit)

Note: The WRU will be supplied with the abatement system enclosure. Alternatively, you can order the system to be supplied with a Services Module (refer to Appendix A8*). If you require another installation configuration, contact BOC Edwards at the address given in* Section 1.13.

You must provide the following services for the WRU:

- Fuel gas supply, for the combustor in the abatement system enclosure.
- Make-up water supply, which is filtered and used to provide a scrubber water supply for the scrubber system in the system enclosure.
- Cooling-water supply, to cool the scrubber water supply to the system enclosure.

The WRU contains all of the devices necessary to regulate the pressures of the scrubber water and fuel gas services supplies, to monitor supply pressures and flows, and to pump the acid waste water from the abatement system enclosure, into your unpressurised acid drain outlet.

(continued on page 6)

The electrical supply and the nitrogen supplies for the components in the WRU are supplied from the abatement system enclosure.

You will connect the fuel gas, make-up water and cooling-water supplies to the inlets on the WRU (see Figure 15).

The WRU has flexible fuel gas and scrubber water outlet pipes which you will connect to the inlets in the abatement system enclosure; you will also connect the water return pipe (from the acid water drain tank) to the WRU: refer to Section 3.9.

1.6 Principle of abatement system operation

1.6.1 Introduction

Refer to Figure 4. During normal operation, process gases from the pumping systems enter the inlets, then pass through the bypass valves [YV-113 to YV-116]. The gases then pass into the combustor (see Section 1.6.2), then through to the three-stage scrubber (refer to Sections 1.6.3 to 1.6.5).

Treated gas passes through the exhaust outlet and into your exhaust-extraction system. Acid waste water from the drain tank is recycled (by the WRU: see Section 1.7.3), and pumped to a non-pressurised outlet to your acid drain system.

A General view of the enclosure
B Standard inlet configuration
C High CF_4 abatement option inlet configuration (TPU systems only)

1. Exhaust gas outlet
2. Fuel gas detector (optional)
3. Control unit
4. Packed tower
5. Ventilation grill
6. WRU
7. Right-hand door
8. Acid water drain tank
9. Water leak detector
10. Drip tray
11. Air blower
12. Cyclone scrubber
13. Quench/weir
14. Left-hand door
15. Combustor
16. Inlet head
17. Combustor sight-glass
18. Inlet pipelines
19. Elbow
20. 'T' piece and spool
21. Bypass valve actuator

Figure 3 - Key

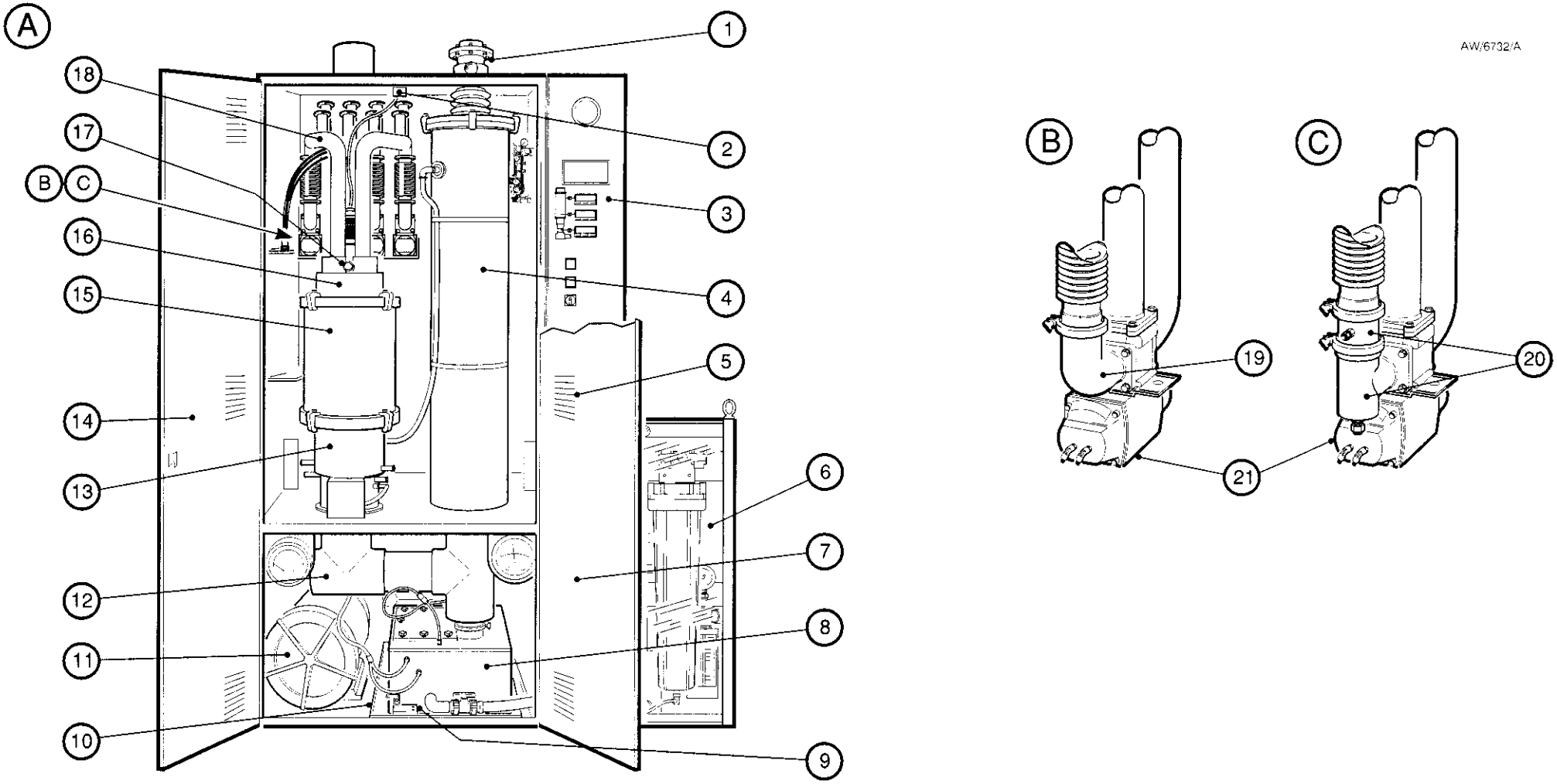

Figure 3 - The abatement system enclosure

Total gas flow rates per inlet (all abatement systems) *	Minimum		Maximum: TCS	Maximum: TPU & Kronis
	With propane or LPG † fuel gas	With methane fuel gas		
Single inlet abatement system	140 l min^{-1}	80 l min^{-1}	280 l min^{-1}	200 l min^{-1}
Two inlet abatement system	70 l min^{-1}	40 l min^{-1}	140 l min^{-1}	100 l min^{-1}
Four inlet abatement system	35 l min^{-1}	20 l min^{-1}	70 l min^{-1}	50 l min^{-1}

Table 5 - Total gas flow rates (per inlet)

* The total gas flow rates into the abatement system inlets must be in the ranges specified above. When you calculate your total gas flow rates into the inlets, you must take account of not only the process gases, but also of any pump purge gas flows and any other additional safety purge gas flows into the pipelines connected to the inlets.

† Liquefied petroleum gas.

WARNING

The total maximum continuous gas flow rates given below are flow rates that ensure safe operation of the TCS. These flow rates will not necessarily provide optimum abatement of the gases. If you require further information contact BOC Edwards for advice.

Chemical symbol	Process gas	Total maximum continuous gas flow rate (sccm) *	Chemical symbol	Process gas	Total maximum continuous gas flow rate (sccm) *
AsH_3	Arsine	Contact BOC Edwards †	Cl_2	Chlorine	Contact BOC Edwards †
BCl_3	Boron Trichloride	Contact BOC Edwards †	ClF_3	Chlorine Trifluoride	Contact BOC Edwards †
BF_3	Boron Trifluoride	400	CO	Carbon Monoxide	8000
B_2H_6	Diborane	2000	F_2	Fluorine	12000
CF_4	Carbon Tetrafluoride	Contact BOC Edwards †	GeH_4	Germane	2000
C_2F_6	Hexafluoroethane	Contact BOC Edwards †	H_2	Hydrogen	50000 ‡
C_3F_8	Perfluoropropane	Contact BOC Edwards †	HBr	Hydrogen Bromide	4000
C_4F_8	Octofluorocyclobutane	4000	HCl	Hydrogen Chloride	40000
CH_4	Methane	16000	HF	Hydrogen Fluoride	38400
CHF_3	Trifluoromethane	6000	NF_3	Nitrogen Trifluoride	6000
CH_2F_2	Difluoromethane	4000	NH_3	Ammonia	20000
CH_3F	Fluoromethane	4000	NO	Nitrogen Oxide	10000

Table 6 - TCS continuous process gas flow rates (sheet 1 of 2)

Chemical symbol	Process gas	Total maximum continuous gas flow rate (sccm) *	Chemical symbol	Process gas	Total maximum continuous gas flow rate (sccm) *
N_2O	Nitrous Oxide	10000	$SiCl_4$	Silicon Tetrachlororide	5000
O_2	Oxygen	20000	SiF_4	Silicon Tetrafluoride	5000
O_3	Ozone	20000	SiH_4	Silane	2000 **
PH_3	Phosphine	2000	$Si(O(C_2H_5))_4$	Tetraethylorthosilicate (TEOS)	4 g min^{-1} ††
SF_6	Sulphur Hexafluoride	Contact BOC Edwards †	$TiCl_4$	Titanium Tetrachloride	4000
$SiCl_2H_2$	Dichlorosilane (DCS)	2000	WF_6	Tungsten Hexafluoride	1600
$SiHCl_3$	Trichlorosilane	2000			

Table 6 - TCS continuous process gas flow rates (sheet 2 of 2)

* The total maximum continuous gas flow rate is the gas flow across all four TCS inlets. The maximum continuous gas flow rate to an individual inlet is this total gas flow divided by the number of inlets.

† Contact BOC Edwards for further advice on these applications.

‡ BOC Edwards H_2 dilution standard is < 4% in N_2, for inherent system safety.

** BOC Edwards SiH_4 dilution standard is < 1% in N_2, for inherent system safety.

†† You must not introduce liquids, either fuels or oxidants, into the abatement system: refer to the warning in Section 2.3.