all the points have been considered, it should be an informed choice.

In addition, because a separation depends so much on the column, mobile phase and operating conditions, it may sometimes be difficult to assess the actual operating performance of a particular feature from the manufacturer's specifications. For some applications it may be necessary to evaluate the performance of the instrument under consideration using the system suitability test mixture chosen for a particular application. The purpose of this is to demonstrate the system's ability to perform a critical separation. HPLC instruments are often sold as complete systems, so that compromises between features may have to be accepted, but it will still be important to distinguish between critical features and those which are optional.

The Committee consider that, in general, HPLC equipment is safe in normal use, but care should be taken to allow sufficient cooling time when changing columns and to take suitable precautions when handling flammable solvents. In addition, eye protection should be worn when aligning or changing UV lamps. It is recommended that a suitable leak detector should be fitted in the column oven.

Finally, as many laboratories are now working to quality standards such as GMP/GLP/NAMAS/ISO Guide 25, some consideration should be given to third party recognition of the manufacturer to standards such as ISO 9001. Such accreditation should extend to the service organisation, which is particularly important when working to NAMAS or GLP criteria.

Previous Reports in this Series from the Analytical Methods Committee

Evaluation of Analytical Instrumentation

Part 1. Atomic-absorption Spectrophotometers, Primarily for Use with Flames, *Anal. Proc.*, 1984, **21**, 45.

Part 2. Atomic-absorption Spectrophotometers, Primarily for use with Electrothermal Atomizers, *Anal. Proc.*, 1985, **22**, 128.

Part 3. Polychromators for Use in Emission Spectrometry with ICP Sources, *Anal. Proc.*, 1986, **23**, 109

Part 4. Monochromators for Use in Emission Spectrometry with ICP Sources, *Anal. Proc.*, 1987, **24**, 3.

Part 5. Inductively Coupled Plasma Sources for Use in Emission Spectrometry, *Anal. Proc.*, 1987, **24**, 266.

Part 6. Wavelength Dispersive X-ray Spectrometers, *Anal. Proc.*, 1990, **27**, 324.

Part 7. Energy Dispersive X-ray Spectrometers, *Anal. Proc.*, 1991, **28**, 312

Part 8. Instrumentation for Gas–Liquid Chromatography, *Anal. Proc.*, 1993, **30**, 296.

Instrument Evaluation Form

Type of Instrument: High Performance Liquid Chromatograph

Manufacturer:

Model No.:

Feature	Definition and/or test procedures and guidance for assessment	Importance	Reason	Score
Non-instrumental criteria				
E46 Tw-instrumental				

Feature	Definition and/or test procedures and guidance for assessment	Importance	Reason	Score
(*iv*) Effective-ness of service engineers	The ability of the service engineers, as judged from previous experience and reports of others, including the carrying of adequate spares.	I	Ability to repair on-site avoids return visit or removal of equipment for off-site repair, so reduces down time and may reduce service cost.	PS WF ST
(*v*) Cost of call-out and spares	It *may* be inappropriate to score this feature if in-house servicing is contemplated.	I	The proximity of the service centre may be a factor in travel costs.	PS WF ST
(*c*) Technical support	As in (*b*) score in consideration of sub-features (*i*)–(*iii*) below.	VI for new user		
(*i*) Advice from applications department	The advice and training available from the manufacturer's applications department.		This helps in-house staff with new applications problems.	PS WF ST
(*ii*) Technical literature	The range and quality of technical literature, including the operating manual.		Guidance on optimum use of instrument suggests manufacturer's awareness of applications.	PS WF ST
(*iii*) Telephone assistance	Willingness of the manufacturer/supplier/contractor to give effective advice over the telephone. This can normally only be evaluated by reference to existing users.		Rapidly available technical help reduces the number of call outs and enhances productivity.	PS WF ST
Instrumental Criteria				
1. *General features*				
(*a*) Facilities required for:				
(*i*) Access and location of connections and controls on instrument	Score according to convenient access taking into account the proposed location of the instrument.	I	Depending on bench position and layout, connections and controls may limit accessibility for servicing and installation, particularly at the rear of the instrument.	PS WF ST
(*ii*				

Feature	Definition and/or test procedures and guidance for assessment	Importance	Reason	Score				
(*c*) Flow range	Score highest for wide range of flow rates if microbore, analytical and preparative columns are to be used.	I	Flow rates required vary from below 1 ml min^{-1} to over 30 ml $min.^{-1}$	PS WF ST				
(*d*) Pulse monitoring	Score highest for systems with built-in accurate pulse monitoring and for lowest pulsation.	I	Pulsation in the flow can give rise to noise problems particularly with electrochemical detectors and hence should be checked.	PS WF ST				
(*e*) Gradient formation; accuracy and reproducibility	Score highest for best accuracy and reproducibility of the eluent mixture commensurate with the application. It may be inappropriate to score this feature as not all applications require gradient elution.	VI	Poor control leads to poor method reproducibility.	PS WF ST				
(*f*) Recycling of mobile phases	Score highest for systems possessing this feature. It may be inappropriate to score this feature.	I	Recycling allows the re-use of mobile phase if costs or runtime are critical.	PS WF ST				
(*g*) Materials of construction	Score highest for durability, as judged from the quality of construction.	I	Poor quality or inappropriate materials can lead to contamination of mobile phases and corrosion of casings and connectors.	PS WF ST				
(*h*) Ease of maintenance	Score highest for systems which have clear 'built in' diagnostics of pump functionality and easy removal of check valves, pistons and heads.	VI	Well maintained pumps are essential to ensure that flow rates are accurate and reproducible.	PS WF ST				
(*i*) Eluent switching	Score highest for systems which allow eluents to be exchanged during analysis.	I	Allows several sets of samples to be analysed in conjunction with column switching [see 5(*c*)].	PS WF ST				
4. *Sample introduction*								
(*a*) Sample loop injection (manual)	For simple instruments, manual injection is usually adequate. Score highest for systems which have the ability to accept fixed or variable loops which: are easy to change; have minimal carry over; have sample loop/ valve preheat; are inert to the solvent system; have the highest reproducibility; have appropriate volumes.	VI	Consistent sample introduction onto the column is a critcal factor in obtaining reproducible peak shapes, areas and retention times. Consistency may mean determining reproducibility of partial as well as complete filling of the sample loop.	PS WF ST				
(*b*) Sample loop injection (automatic)	In addition, for more complex systems, score highest for systems which have these additional features: have thermostating of the sample tray; have full software control of injection numbers and sequence; are able to perform liquid transfers or dilutions.	VI	As above.	PS WF ST				
5. *Columns and fittings*	(Column materials and stationary phases are outside the scope of this evaluation.)							
(*a*) Pre-columns	If applications require one, score highest for systems which: are easy to fit; have low dead volume; are robust; are low cost.	I	Pre-columns can prolong the life of the main column but must not significantly reduce the overall efficiency of the system.	PS WF ST				
(*b*) Cartridge columns	Score highest for systems which allow a full range of column configurations and connections.	I	Cartridge columns can make column changing easier and quicker.	PS WF ST				
(*c*) Column switching	Score highest for systems which allow full control of valves and pneumatic systems.	I	Allows several sets of samples and/or columns with different eluents to be run consecutively. This may be important for method development.	PS WF ST				
(*d*) Connectivity (compatibility of components)	Score highest for fittings with standard thread sizes and uniform external dimensions.	I	Allows ease of interchangeability of components between systems and reduces spares requirements.	PS WF ST				
6. *Column ovens*								
(*a*) Oven design; size, shape and special features	Oven design must allow easy accommodation of user selected columns and have an adequate thermal capacity. These are special requirements for multi-column, post-column reactor or preparative work. Score accordingly.	I	Usually only one column is employed but for some applications pre-columns or guard columns are required. Sufficient space is required for ease of installation or replacement.	PS WF ST				

Feature	Definition and/or test procedures and guidance for assessment	Importance	Reason	Score
(*b*) Temperature control	Score highest for ovens with the ability to maintain precise temperature control over the range (ambient + 5) °C to 80 °C.	VI	Accuracy and precision of temperature control are important, particularly in separations using buffers or ion pairing, *etc*., if reproducible chromatography is to be obtained.	PS WF ST
(*c*) Temperature uniformity	Score highest for least temperature gradient effects and additional for adequate control of eluent temperature at the column inlet and exit so that it is unaffected by the flow rates and solvent compositions used.	I	The oven's thermal capacity and control of temperature distribution must be adequate to prevent temperature effects distorting the chromatography.	PS WF ST
(*d*) Solvent inert construction	tf torganic olvent with ou comrroson mr ovherm damageI Tolvent ies cnecssmaryfor leong-term urebility	cS WF ST		