MANUAL

ON-LINE PROCESS STREAM ANALYSIS
PART 2: SAMPLE CONDITIONING

DEP 32.31.50.11-Gen.

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DESIGN AND ENGINEERING PRACTICE

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APPENDICES

1. INTRODUCTION

1.1 GENERAL

This manual, the subject of which previously formed part of DEP 32.31.50.31-Gen., 'On-line process stream analysers' dated September 1970, gives guidance for the design and construction of sample conditioning systems for on-line process stream analysers and for the disposal of sampled fluids.

It shall be used in conjunction with DEP 32.31.51.95-Gen., 'Requisition for sample conditioning systems for analysers'.

This manual supersedes Standard Drawings S 31.441, S 31.461, S 31.462, S 31.465, S 31.467 and all drawings in the S 31.6xx series. These drawings have been replaced by typical arrangements which are included as Appendices 1 to 6 of this manual.

This publication is Part 2 of a series of on-line process stream analysis manuals, under the subject heading of:

Part 1:	Sample take-off and transport	-	DEP 32.31.50.10-Gen.
Part 3:	Analysers	-	DEP 32.31.50.12-Gen.
Part 4:	Analyser houses	-	DEP 32.31.50.13-Gen.

The type of connections previously applied for sample conditioning systems, i.e. DN 15 line pipe, elbows, tees, nipples, unions and flanges have been replaced in this manual by tubing and compression fittings.

The drawings of Parts 1, 2 and 3 have been prepared to form a complete loop, matching each other on incoming and/or outgoing connections.

This publication is intended for use in oil refineries, chemical plants, gas plants and where applicable, in exploration, production and new ventures.

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All publications referred to in this manual are listed in Section 10.

Where cross references are made, the number of the section or sub-section referred to is shown in brackets.

1.2 DEFINITIONS

For the purpose of this manual, the following definitions shall hold:

Shall and **Should** - the word 'shall' is to be understood as mandatory and the word 'should' as strongly recommended to comply with the requirements of this manual.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements.
The Principal may also include an agent or consultant, authorized to act for the Principal.

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project.
The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

Pipe Sizes: The international nomenclature **Diameter Nominal** written as DN 15, 25, 40, 50, etc. has been used for pipe sizes in this manual.

Data/Information indicated as 'specified by the principal' shall form a part of the requisition.

Where **Materials** are specified as 'stainless steel' they shall be made of AISI 316 type stainless steel.

2. GENERAL

Sample conditioning systems should be designed and constructed as described in Section 3 of this manual and in accordance with the typical arrangements given in Appendices 1, 2 and 3, selecting the components from the list of Appendix 7.

The materials of construction should be stainless steel: , however, for oxygen, corrosive or toxic/noxious services, other materials and/or additional provisions should be considered, see Section 4.

Sample disposal systems are described in Section 5 and typical details of a vent and drain system are given in Appendix 4.

Heating, winterizing and/or insulation requirements are given in Section 6.

The requirements for electric and electronic equipment are specified in Section 7.

Detailed drawings shall be prepared to scale, see Section 8, based on the appropriate specifications of the above Sections and Appendices.

The requirements for testing and inspection are given in Section 9.

3. SPECIFICATIONS FOR SAMPLE CONDITIONING SYSTEMS

3.1 GENERAL

The sample conditioning system shall be designed to supply the sample at the required analyser inlet conditions.

Depending on the application, a sample conditioning system will be made up from the following components:

- filter(s) (3.2)
- pressure reducer(s) (3.2)
- variable area flow meter(s) (3.2)
- relief valve(s) (3.2)
- multi-stream switching valve(s) (3.2)
- excess flow valve(s) (3.3)
- cooler(s) (3.4)
- heater(s) for heating or preventing freezing (3.4)
- vessel(s) for test/calibration services (3.5).
- tubing and compression fittings (3.2).

For typical examples, see Appendix 2. The selected make(s) and type(s) of component shall be as specified in the requisition.

3.2 SPECIFICATION OF COMPONENTS

For general applications, all wetted parts shall be of stainless steel. The make(s) and type(s) of components, tubing and compression fittings shall be as specified by the principal.

When selected in the requisition, preference shall be given to components with compression fitting-ends manufactured by the same compression fitting manufacturer.

The design pressure of components and tubing shall be in accordance with ANSI/ASME B 31.3. The design pressure for sample conditioning systems provided with a relief valve, referred to the pressure level at which the relief is installed, shall be not less than:

- for MOP between atmospheric and 17 bar (ga) = MOP + 1.7 bar
- for MOP between 17 bar (ga) and 40 bar (ga) = 110% of MOP
- for MOP between 40 bar (ga) and 80 bar (ga) = MOP + 4 bar
- for MOP above 80 bar (ga) = 105% of MOP.

MOP = Maximum Operating Pressure.

Special attention shall be paid to the pressure ratings, the tolerances for outside diameter and wall thickness of the tubing. The tubing shall meet the requirements of ISO 4200 for metric sizes and when applicable ASTM A 269 for imperial sizes.

The application of either metric or imperial sized tubing and compression fittings shall be specified in the requisition.

The reliable application of compression fittings require that:

- the compression fittings are of the make as specified by the principal and of which all parts of the fitting are made by one manufacturer
- the tubing conforms to the specification supplied by the principal
- the fittings and tubing are strictly installed in accordance with the manufacturer's instructions
- the systems are pressure-tested after construction (9.).

NOTE: It shall be ensured that imperial sized tubing and metric compression fittings or metric sized tubing and imperial compression fittings are not used in combination because this will result in unreliable joints.

Sample conditioning systems shall have facilities for flushing, venting and/or draining, with vent and/or drain valve(s). The vent/drain outlets shall be connected to a vent or a drain system (5.).

NOTE: Vent plugs shall not be applied.

Instrument air supply lines and pneumatic signal lines should normally be made up from PVC covered copper tubing, brass compression fittings and components.
However, when specified by the principal, the air supply and signal lines shall be made up from stainless steel tubing and stainless steel compression fittings.

NOTE: Mixing of different materials, e.g. brass and stainless steel, is not permitted.

Stainless steel tubing for air lines should be colour coded blue, with paint or PVC tape, at intervals of approximately 100 mm and close to the connection points. The width of the coding shall be 10 to 15 mm.

When specified by the principal, supply lines for nitrogen, carrier gas and cooling water shall also be colour coded.

Pressure gauges for sampled fluids should have a 100 mm dial and be provided with a $^1/_2$ inch threaded connection. The type of thread shall be as specified in the requisition.

Pressure gauges which can be depressurized in the conditioning system, shall be installed on a gauge adapter or connected to a $^1/_2$ inch female threaded compression fitting which shall be supported from the mounting plate, see Appendix 3.

Pressure gauges which cannot be depressurized in the conditioning system, shall be provided with isolate-and-vent valve facilities. The vent/drain outlet shall be connected to a vent or drain system (5.).

Instrument air supply and nitrogen supply lines shall be provided with a filter reducer complete with a pressure gauge and back flow protection. The nitrogen reducer shall be of the non-bleeding type.

NOTE: Pressure gauges for reducers and filter reducers should have a 50 mm dial and shall be provided with a 1/4 inch NPT threaded connection.

Special attention shall be paid to the following:

- Solenoid valves shall be applied only for switching instrument air and nitrogen.
  For all other fluids a pneumatically operated valve used in combination with a solenoid valve shall be selected. The pneumatic actuator shall be provided with a direct-coupled mechanical position indicator.
- Components or parts thereof made of glass, should not be applied for flammable and toxic/noxious fluids. When all steel components for a particular range and/or duty are not commercially available, the contractor/ manufacturer shall obtain written agreement from the principal to apply glass-containing components.
  When applied, glass or glass-containing components shall be suitable for 1.5 times the maximum operating pressure of the related system and shall be provided with 5 mm thick polycarbonate screens for personnel protection.

  NOTE: Variable-area flow meters shall have a metal metering tube.

  Deviation from the above requires the written approval of the principal.
- Relief valve(s) shall be installed to protect those components installed in a system which have a limited pressure rating, e.g. sample conditioning vessels and glass-containing components. The relief valves shall be connected to a vent or a drainage system as required.

3.3 FLOW RATE TO ANALYSERS

The total amount of flammable fluids flowing to the analyser shall be limited by an excess flow valve.

The following requirements shall be met:

- the maximum flow rate of flammable gases shall not exceed 20 Nl/hour.
- the liquid flow rate shall not exceed the maximum required flow rate, as specified by the manufacturer of the analyser concerned.

NOTES: 1. Flow rates exceeding the above limits, need the approval of the principal in writing.

2. The excess flow valve shall be a self-closing type to prevent exceeding the above limits.

3.4 COOLING AND HEATING OF SAMPLES

Cooling or heating as appropriate, shall be provided in the sample conditioning system for analysers requiring a sample inlet temperature within specified limits.

Where cooling is required 'sweet' water from the main cooling systeem should be used.

NOTE: The maximum temperature of the cooling water supply during hot seasons and in tropical locations shall be the design temperature.

Where the cooling water temperature is too high, cooling by means of cold air from a vortex tube or by refrigeration or other mechanical cooling shall be considered. However, the application of mechanical coolers requires the written approval of the principal.

When heating is required to lower the viscosity or to prevent condensation of gaseous samples or absorption in materials, the application shall be in accordance with Section 6.

3.5 TEST AND CALIBRATION VESSELS

For analysers which require liquid samples for testing and calibration, a vessel shall be provided bolted to the sample conditioning rack.

Where heat is required to lower the viscosity or to prevent freezing of the liquid, a stainless steel steam heating coil shall be installed around the vessel. Where steam is not available, electrical heating tape of the self-regulating type should be applied.

The thermal insulation around vessel and heating facilities shall have a guaranteed maximum chloride content of 10 mg/kg and be sealed against water ingress, in order to prevent chloride stress corrosion.

For dimensions of the vessel, see Appendix 5.

NOTE: For calibration facilities further to the above, see DEP 32.31.50.12-Gen.

3.6 MOUNTING ARRANGEMENTS

All components shall be installed on a stainless steel mounting plate, which shall be fixed to the sample conditioning rack with flat, countersunk headed stainless steel bolts.

The sample conditioning rack shall be selected from one of the following types:

- freestanding
- floor mounting (which will require additional support)
- wall mounting.

Constructed in accordance with one of the following executions:

- welded version, all material of stainless steel
- welded version, all material of carbon steel, hot-dip galvanized in accordance with the requirements of ASTM A 123 or BS 729, after drilling and welding. The nuts shall be retapped after galvanizing
- bolted version, all materials of prefabricated stainless steel, U or H profile (e.g. UNISTRUT) with mounting strips/ plates, bolts and nuts.

The type and execution of the rack(s) shall be as specified by the principal. For typical examples, see Appendix 1.

NOTE: The manufacturer/supplier shall design the conditioning rack(s), mounting plate(s) and support(s) for the total weight of all the components including the weights of fluid(s).

Components should be attached to the mounting plate with bolts and nuts, the nuts being permanently fixed to the mounting plate. Special attention shall be paid to the position of the components in relation to the connections to be made.

NOTE: Components such as ball valves and non-return valves, may be supported by their connecting tubing by means of stainless steel attachments adjacent to the tubing connections.
Non-metallic spacer material, e.g. Teflon hose, shall be applied to isolate the tubing from the supports.

Bulkhead unions shall be supported from the mounting plate. The lock nut shall be located on the conditioning side of the system.

Prefabricated sample conditioning systems shall be supplied with engraved nameplates in accordance with DEP 32.37.10.34-Gen. The nameplates should be fixed directly to the mounting plate but where their descriptions may be obstructed by components and/or tubing, a separate nameplate support shall be provided attached to the mounting plate. Nameplates shall be fixed to the supports with stainless steel screws.

All incoming and outgoing connections shall be identified with an engraved nameplate. Components such as relief valves, excess flow valves and variable-area flow meters shall also be provided with nameplates showing their settings.

In addition to the above, incoming and outgoing connections at thermal insulation enclosures (6.4) for sample conditioning systems, shall be provided with nameplates on the outside of the enclosure.

Compression fittings shall be provided with parallel threaded connections in accordance with Standard Drawing S 37.808. The stainless steel sealing ring shall be as specified by the principal.

NOTE: The thread surfaces require lubrication with a suitable compound.

The compression fitting shall be locked to the body of the relevant component with a locking pin.

NOTES:
1. NPT threaded compression type elbows shall not be applied, because length of engagement of the threads is considered insufficient when correct alignment is obtained.

2. NPT threaded connections require special provisions to prevent seizing and leakage.
For temperatures between -100°C and +200°C, PTFE tape (MESC 85.15.78.038.1) shall be applied as follows:

   - Place tape on the male thread, leaving two threads at the small end free from tape, hold in place and wrap clockwise once only with a half tape width overlap. Draw tightly around the threads so that it conforms to the threaded surface.

The tubing shall be arranged such that the removal of one component will not require the dismantling of other parts. The components shall also be installed in different planes to avoid the need for bends when crossings have to be made. For details see Appendix 3 - 'Sample inlet and return with by-pass valve' on page 2 and 'Hook-up of a filter' on page 4.

The tubing shall be cut dead square with a tube cutter and the tube edges shall be deburred. The tube end shall be undamaged, round and without scratches over the length which fits into the compression fitting. Any coating or painting shall be removed.

The tubing shall be bent with a high-quality tube bender to at least the minimum bending radius as specified by the tubing manufacturer.

NOTE: Special attention shall be paid to tubing made of other materials such as Monel, Hastelloy or Incoloy (4.3). The recommended minimum bending radii for tubing in these materials may be larger than those specified for stainless steel.

4. SPECIAL APPLICATIONS

4.1 GENERAL

To ensure an efficient operation of the sample conditioning system under all operational and climatic conditions, certain applications require provisions in addition to, or in deviation from those specified in Section 3, e.g. the use of special materials and/or components and heating (6.) or a combination thereof.

4.2 OXYGEN SERVICES

All materials for gaseous-oxygen applications shall be carefully degreased and inspected in accordance with the requirements of DEP 31.10.11.31-Gen.

4.3 CORROSIVE SERVICES

For applications where stainless steel is not suitable, preference shall be given to materials such as Monel, Hastelloy or Incoloy.

When components made of the above materials cannot be commercially obtained, then Teflon may be considered.

The application of any of the above materials requires the written approval of the principal.

4.4 TOXIC AND NOXIOUS SERVICES

All vents for toxic and /or noxious services shall be connected to a vent for toxic products or alternatively to a flare system. All drains shall be directed to a drainage vessel or a covered pit allocated to receive toxic products.

The sample conditioning system shall have flushing facilities for neutralization, terminating in a valve with a compression fitting. An armoured hose or coiled tubing, provided with compression fitting ends should be used to flush the components and tubing. When the flushing connection is not in use it shall be closed with a compression fitting type plug, secured by means of a bead-type chain to the compression fitting or to the isolating valve body.

The sample conditioning system shall be provided with a red nameplate bearing the inscription in white:

'ATTENTION TOXIC/NOXIOUS SERVICE'

The letter height shall be 10 mm.

4.5 SOUR SERVICES

All components for sour services shall comply with the requirements of NACE Standard MR-01-75 and Section 3.2.3 of DEP 31.38.01.11-Gen., 'Piping general requirements'.

When components and/or parts of them as required for the application, cannot be obtained in accordance with the requirements of the NACE Standard, Hastelloy-C or type 17-4 PH stainless steel should be used.

Typical examples are:

- valve head spindles
- compression fittings.

The wetted parts of the components shall meet the hardness requirements of the NACE Standard.

The application of complete components made of Hastelloy-C requires the written approval of the principal.

The threads of screwed components shall be coated with a lubricant/sealing material before installation to prevent corrosion.

The following compounds are recommended:

- 'SWAK' for temperatures up to 200 °C, as supplied by the 'Crawford Fitting Company' of America.
- 'LIQUID-O-RING' for temperatures above 200 °C as supplied by Liquid-O-Ring Ltd.

5. SAMPLE DISPOSAL SYSTEMS

5.1 GENERAL

Samples should be returned back into the process stream.

For those applications where other arrangements are required for technical reasons, the samples should be directed to:

- a flare system (5.2)

  or

- a recovery system (5.3)

  or

- an effluent system (5.4).

When waste gases or vapours cannot be returned to one of the above systems they should be vented to the atmosphere in such a way that:

- they are discharged at a safe height and in a safe direction
- flammable conditions are not created
- the number of venting points are limited to a minimum.

For typical vent details, see Appendix 4.

Venting to atmosphere requires the principal's written approval.

5.2 GAS DISPOSAL TO FLARE

Hydrocarbon gases or vapours which cannot be returned to the process should be discharged to a flare system.

Flare systems normally operate at varying pressures, the maximum operating pressure shall be specified by the principal.

The effluent gas pressure shall be kept constant by means of a back-pressure regulator.

5.3 LIQUID DISPOSAL TO RECOVERY SYSTEM

Hydrocarbon liquids which cannot be returned to the process shall be discharged into one of the following systems:

- plant hydrocarbon recovery system

  or

- drain pit for hydrocarbon products.

It shall be ensured that the total quantity of liquids disposed of is limited to the minimum necessary for adequate sampling.

5.4 LIQUID DISPOSAL TO EFFLUENT SYSTEM

Aqueous effluents shall be disposed of via dedicated effluent systems which are normally handled as follows:

- 'clean effluent' for aqueous fluids which are always clean
- 'normally clean effluent' for aqueous fluids which are normally clean but may become contaminated in emergencies
- 'contaminated effluent'.

NOTE: Aqueous fluids from analysers using reagents shall be discharged into contaminated effluent systems.

5.5 VENT AND DRAIN SYSTEMS

Vent and drain systems should be installed in the conditioning area against the outside wall(s) of the analyzing part of the house and should be adequately supported at intervals of 1 metre maximum.

The vent and drain systems will be selected by the principal from the following executions to suit the application:

- carbon steel, all-welded construction
- stainless steel, AISI type 316, all-welded construction
- rigid PVC plastic, cemented construction in accordance with the requirements of DEP 31.38.01.12-Gen.

The minimum size of the piping for vent header(s) shall be DN 50 and for liquid headers DN 80.
The interconnecting piping shall be minimum DN 15.

Connections to drain headers without isolating valve shall be provided with a goose neck liquid seal.
Where required, a funnel and goose neck liquid seal shall be installed, see Appendix 6.

Special attention shall be given to ensure the segregation of water and oil drain headers (5.3) (and 5.4).

NOTE: Cooling water shall not be discharged into condensate return systems.

For a typical example of a vent and drain system, see Appendix 4.

6. HEATING, WINTERIZING AND INSULATION

6.1 GENERAL

Heating of sample conditioning systems when required, should preferably be by steam. When steam is not available, or when specifically requested by the principal, electric heating shall be applied. A prefabricated thermal insulating enclosure around components and heating facilities shall be provided.

Open drains, such as funnels, shall be installed outside the enclosure.

NOTE: Electric and electronic components, such as solenoid valves, switches and timer devices should not be installed inside the enclosure.

All electrical and electronic components shall meet the requirements as specified in Section (7.).

6.2 HEATING AND WINTERIZING

Low-pressure steam at 3.5 bar (ga) should be used for heating purposes. When higher temperatures are required, medium- pressure steam up to 18 bar (ga) may be considered.

The arrangement of the steam heating shall be such that the heating equipment does not obstruct other components.

Sample conditioning systems which operate at constant temperature shall be provided with a self-acting temperature controller installed in the top or on top of the enclosure.

A temperature gauge of dial size 50 mm, shall be installed in the door with the indicator outside the enclosure.

Each sample conditioning system shall have its own steam supply and condensate return connections, complete with isolating valves labelled with the tag number of the system. The valves shall be installed outside the enclosure.

Each steam heater shall terminate in a condensate return line.

Steam supply and condensate return lines form part of mechanical engineering.

6.3 ELECTRIC HEATING

Electric heaters shall be provided with a thermostat which controls the temperature within plus and minus 3°C of the required setting. All electric equipment shall meet the requirements as specified in Section 7. The arrangement of the electric heating shall be such that the heating equipment does not obstruct other components.

6.4 INSULATION

Sample conditioning systems provided with heating facilities shall have enclosures which are constructed from glass-fibre-reinforced polyester or from stainless steel plates insulated with mineral wool.

The chloride content in the mineral wool insulation should not exceed 10 mg/kg.

The enclosures shall be provided with a door in the front. Enclosures in which the temperature needs to be kept above 50° C, shall be provided on the front of the door with a red nameplate bearing the inscription in white:

'ATTENTION HIGH-TEMPERATURE SERVICE'

The letter height shall be 10 mm.

Hinges and locks shall be made of stainless steel.

The type of enclosure shall be as specified by the principal.

NOTE: Special attention shall be paid to the installation of the mounting plate inside the enclosure and to the accessibility of components.

Vent, drain and condensate return lines may also require insulation and/or heat tracing to prevent freezing.

7. REQUIREMENTS FOR ELECTRIC AND ELECTRONIC EQUIPMENT

Unless otherwise specified, all electric and/or electronic equipment shall have a type of protection adequate for the zone in which they are installed.

For open ventilated areas the Zone Classification for the components shall be Zone 2 minimum.

Electric equipment installed inside the sample conditioning enclosure shall meet the requirements of IEC 79-14 and shall:

- have a type of protection adequate for Zone 2, when the sources of release do not contain flammable substance
- have a type of protection adequate for Zone 1 when only secondary grade sources of release of flammable substance are present
- have a type of protection adequate for Zone 0 when primary grade sources of release of flammable substance are present.

NOTES:
1. The application of non-ventilated sample systems with primary grade sources of release requires written approval of the principal.
2. Continuous grade sources of release of flammable substance are not permitted.
3. Components without a type of protection adequate for Zone 2 shall be installed close to the relevant analyser in the analyser house. See DEP 32.31.50.12-Gen.
4. For details of area classification, refer to IEC 79-10.

The sample conditioning rack, the mounting plate and when applied the stainless steel enclosure, shall be provided with a brass M8 earthing bolt.

All electrical equipment shall be connected to the plant earth by an insulated wire for personnel protection. The colour coding of the insulation shall be yellow/green.

8. INSTALLATION DRAWINGS

A set of drawings shall be prepared to scale by the manufacturer/supplier for all sample conditioning systems showing in detail:

- the correct position of components on the mounting plate
- the arrangement of the interconnections
- the method of supporting
- a list of materials required.

Typical 'hook-up' drawings and examples fulfilling the above requirements are given in Appendices 1, 2 and 3, with a list of components in Appendix 7.

'Engineering notes' have been included on the drawings to assist in the proper use thereof.

The drawings shall be assembled in one set for each sample conditioning system, complete with cover sheet, index sheet, list of materials, list of settings, technical information and when applicable, test certificates.

When specified by the principal, the manufacturer/supplier shall include an operating instruction for start-up and maintenance of the sample conditioning system.

The manufacturer/supplier shall send the drawings to the principal for comments, at least 20 working days before construction work commences.

Three copies of the as-built drawings shall be shipped together with the sample conditioning system.

NOTE: The manufacturer/supplier may wish to apply a computerized system for the handling of components and installation materials which should provide the following information:

- itemized material requirements per conditioning system
- total requirements per item
- information of material ordering.

If the manufacturer/supplier intends to use such a computerized system, he shall obtain written agreement from the principal on the format and contents of the computer output sheets.

9. TESTING AND INSPECTION

The manufacturer/supplier shall pressure test and inspect the sample conditioning system before the system is offered for inspection by the principal.

The manufacturer/supplier shall make available for the test and/or inspection:

- sufficient qualified labour to carry out the test
- air or nitrogen at a minimum pressure of 10 bar (ga) for the full duration of the test/inspection
- air bubbler, maximum working pressure 10 bar (ga)
- a leak detector, for example the product known as 'Snoop', supplied by the 'Crawford Fitting Company'
- measuring equipment for supplies and outputs
- special measuring tools/equipment for components installed
- power supply units as applicable, e.g. 24 V DC and 220 V AC
- three copies of the as-built drawings (8.)

NOTE: The manufacturer/supplier shall ensure that all documentation, including material and/or construction certificate(s) for vessel(s) and/or components as applicable, is available before inspection starts.

Testing and inspection procedures:

1. General

- The system shall be checked against the as-built drawings and when applicable the related certificates.

2. Leak test

- The complete system shall be leak-tested by pressurizing via a bubbler with air or nitrogen at 1.1 times the design pressure of the system. When relief valve(s) form part of the system, the relief setting shall be the maximum applied pressure to test the system.

  Inlets and outlets shall be capped-off with the exception of those which are provided with a valve. The isolating valve shall be closed for these connections. All other valves and reducers shall be fully opened.

  The maximum pressure applied shall not exceed 10 bar (ga).

- The system shall be pressurized for at least 5 minutes, while the bubbler is carefully observed.
- If there are signs of leakage, the manufacturer/supplier shall correct the leaking connection(s)/component(s).

3. Hydrostatic test

- Systems or parts of systems with a design pressure up to 9 bar (ga) shall be isolated from other parts of the system having a higher design pressure, and shall be opened to atmosphere during the hydrostatic test.
- Systems or parts of systems with a design pressure higher than 9 bar (ga) shall be pressurized at 1.5 times the design pressure via a tight shut-off valve and a high-quality pressure gauge (error to be within 0.5 % of the maximum scale value in the range of 10 % to 100 % of the scale).

  NOTE: Fluids used for testing shall be compatible with the fluids to be analysed.

- The pressure in the system shall remain constant for at least 10 minutes after closing the tight shut-off valve.
- The system shall be thoroughly dried with clean dry air or nitrogen after draining.

4. Function test

- All electrical and electronic components shall be connected to the applicable power supplies and shall be function-tested.

10. REFERENCES

In this manual, reference is made to the following publications.

NOTE: The latest issue of each publication shall be used together with any amendments/supplements/revisions to such publications.

It is particularly important that the effect of revisions to international, national or other standards shall be considered when they are used in conjunction with DEPs unless the standard referred to has been prescribed by date.

Gaseous-oxygen systems	DEP 31.10.11.31-Gen.
Piping general requirements	DEP 31.38.01.11-Gen.
Piping classes	DEP 31.38.01.12-Gen.
On-line process stream analysis Part-1 Sample take-off and transport Part-3 Specification and installation of analysers Part-4 Analyser houses *In course of preparation.	DEP 32.31.50.10-Gen.* DEP 32.31.50.12-Gen.* DEP 32.31.50.13-Gen.*
Requisition for sample conditioning systems	DEP 32.31.51.95-Gen.
Instrument nameplates	DEP 32.37.10.34-Gen.

AMERICAN STANDARDS

Sulfide stress cracking resistant metallic material for oil field equipment	NACE standard MR-01-75

Issued by
National Association of Corrosion Engineers,
1440 South Creek, Houston,
Texas 77084, USA

Specification for zinc (hot galvanized) coatings on products fabricated from rolled, pressed and forged steel shapes, plates bars and strip	ASTM A 123
Specification for seamless and welded austenitic stainless steel piping for general refinery service	ASTM A 269

Issued by
American Society for Testing and Materials,
1916 Race St., Philadelphia,
Pa. 19103, USA

Chemical Plant and Petroleum Refinery Piping	ANSI/ASME B 31.3

Issued by:
The American Society of Mechanical Engineers,
345 East 47th Street,
New York 10017, USA

BRITISH STANDARDS

Hot dip galvanized coatings on iron and steel articles	BS 729

Issued by:
British Standards Institution
2 Park Street,
London W1A2BS, UK

GERMAN STANDARDS

Screwed plugs, tapped holes, with Whitworth pipe threads: , general outlay of types	DIN 3852 Part 2

Issued by:
Beuth Verlag GmbH,
Burggrafenstrasse 4-10,
1000 Berlin 30,
W.Germany

INTERNATIONAL STANDARDS

Plain end steel tubes, welded and seamless - General tables of dimensions and masses per unit length	ISO 4200

Issued by
International Organization for Standardization,
1, rue de Varembé,
Post Box 56,
CH-1211 Geneve 20, Switzerland

Electrical apparatus for explosive gas atmospheres: Part 10: Classification of hazardous areas Part 14: Electrical installations in explosive gas atmospheres (other than mines)	IEC-79.10

Issued by:
Central Office of the International
Organisation for Standardization,
3, rue de Varembé,
CH-1211 Geneve 20, Switzerland

11. APPENDICES

APPENDIX 1 TYPICAL EXAMPLES OF SAMPLE CONDITIONING RACKS

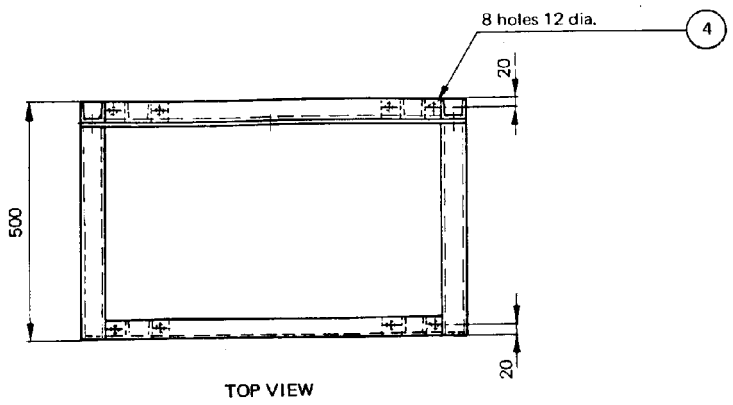
Freestanding type, welded version

Enlarged freestanding type, welded version

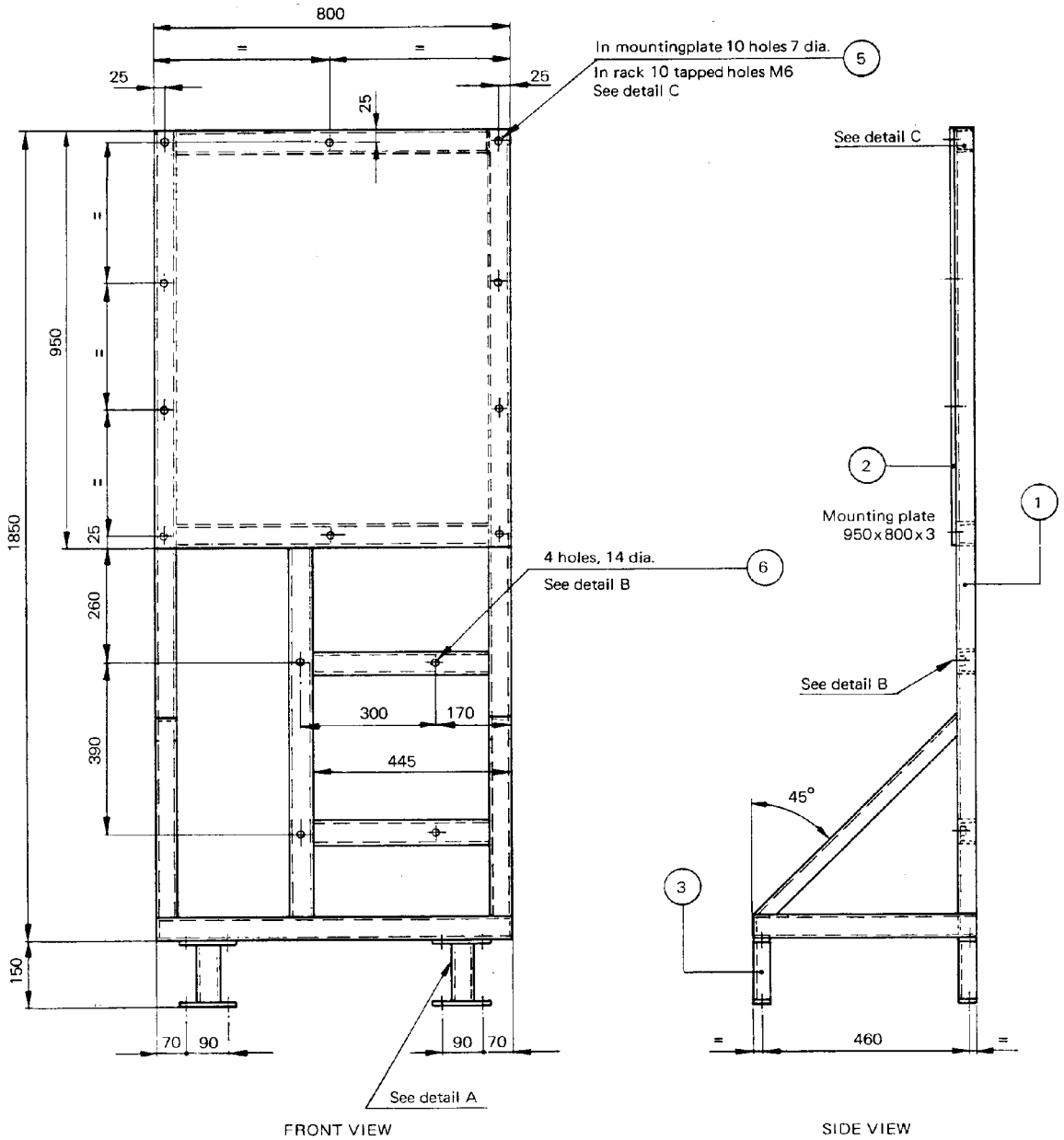
Floor mounting type, bolted version

Wall mounting type, welded version

TYPICAL EXAMPLES OF SAMPLE CONDITIONING RACKS (cont'd)

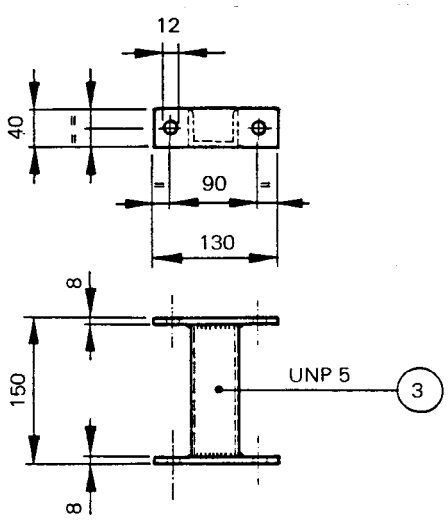


TOP VIEW

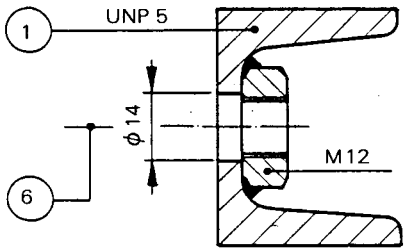


FRONT VIEW

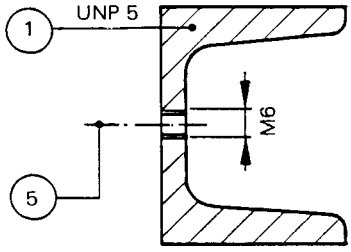
SIDE VIEW



DETAIL A



DETAIL B



DETAIL C

Item	Qty.	Description	Material	Remarks
1	1	Mounting frame UNP 5	See note 1	
2	1	Mounting plate 950x800x3 mm	Stainless steel 316	
3	4	Support	See note 1	See detail A
4	8	Bolt and nut M10	Stainless steel	
5	10	Bolt M6x25	Stainless steel	See detail C
6	4	Bolt and nut M12x40	Stainless steel	See detail B

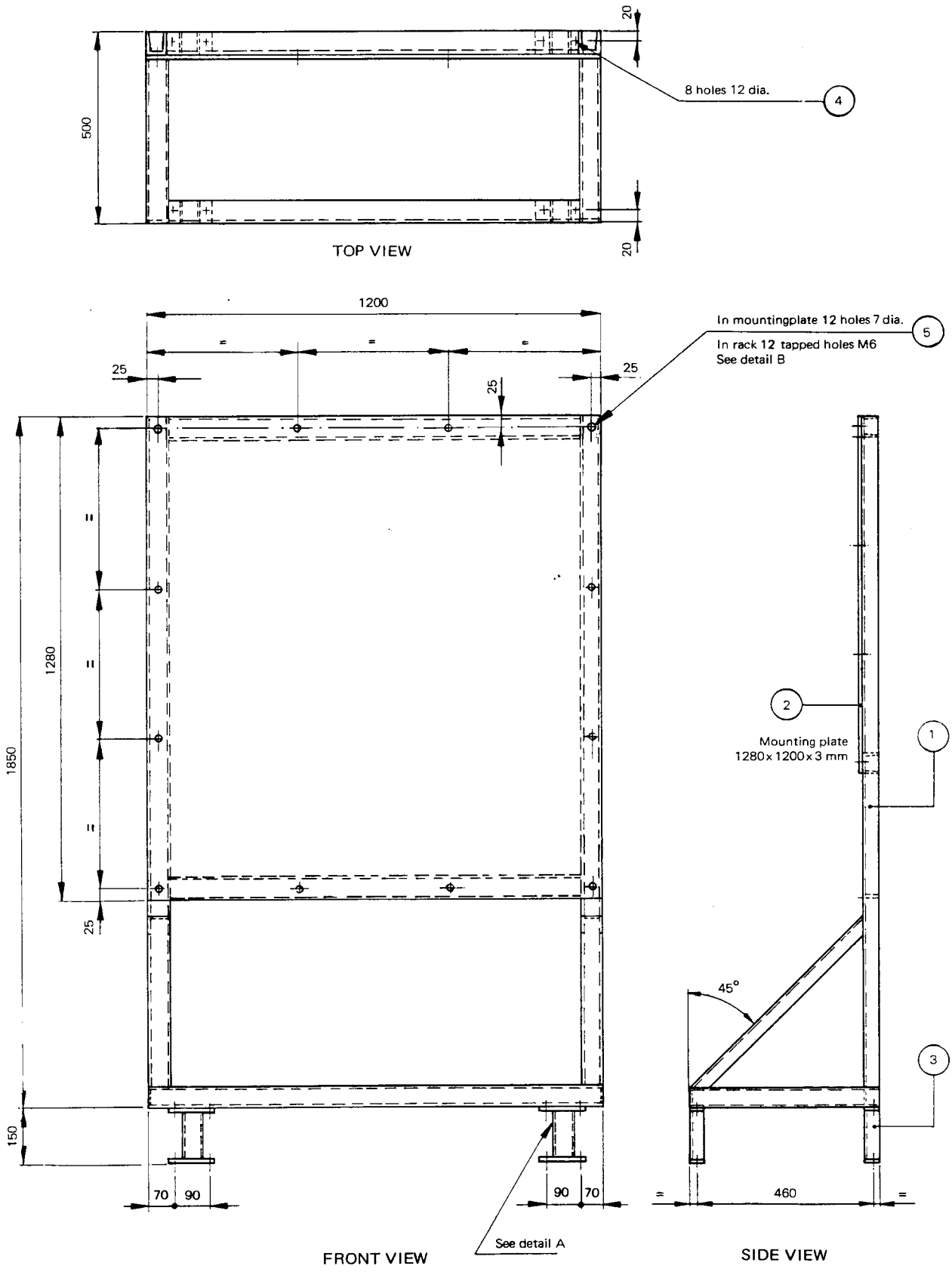
Engineering notes:

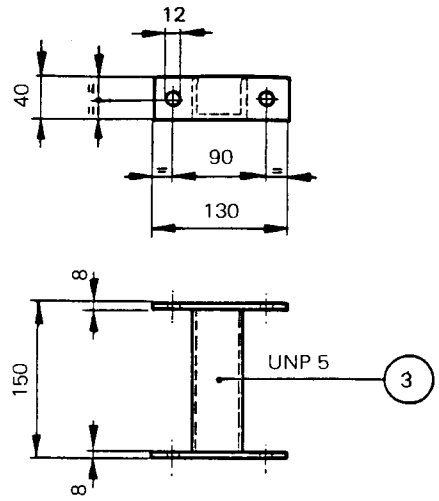
1. Rack and supports to be constructed from either stainless steel 316 or carbon steel which shall be hot dip galvanised to ASTM A123 or BS 729 after drilling and welding. After galvanizing the nuts shall be re-tapped.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

TYPICAL SAMPLE CONDITIONING RACK

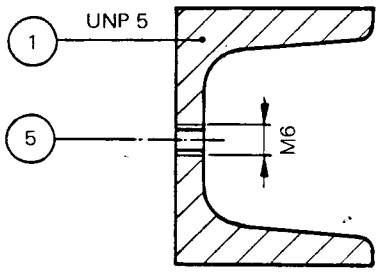
(FREE STANDING TYPE, WELDED VERSION)

TYPICAL SAMPLE CONDITIONING RACK
(FREE STANDING TYPE, WELDED VERSION)(cont'd)





DETAIL A



DETAIL B

Item	Qty.	Description	Material	Remarks
1	1	Mounting frame UNP 5	See note 1	
2	1	Mounting plate 1280 x 1200 x 3 mm	Stainless steel 316	
3	4	Support	See note 1	See detail A
4	8	Bolt and nut M10	Stainless steel	
5	12	Bolt M6 x 25	Stainless steel	See detail B

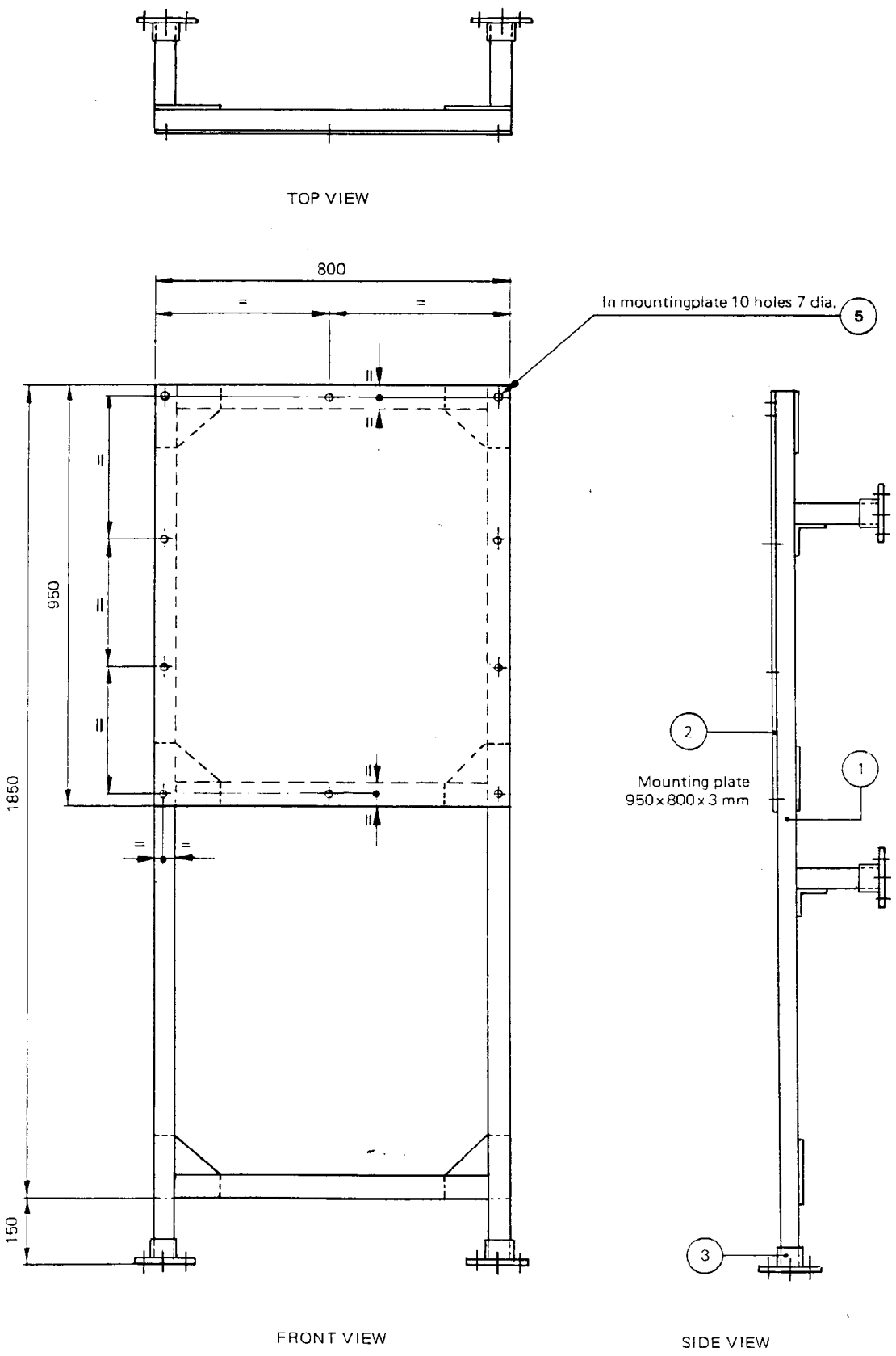
Engineering notes:

1. Rack and supports to be constructed from either stainless steel 316 or carbon steel which shall be hot dip galvanised to ASTM A123 or BS 729 after drilling and welding. After galvanizing the nuts shall be re-tapped.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

TYPICAL SAMPLE CONDITIONING RACK

(ENLARGED FREE STANDING TYPE, WELDED VERSION,

TYPICAL SAMPLE CONDITIONING RACK
(ENLARGED FREE STANDING TYPE, WELDED VERSION,Cont'd)



Item	Qty.	Description	Material	Remarks
1	1	Mounting frame	See note 1	
2	1	Mounting plate 950x800x3 mm	Stainless steel 316	
3	6	Base plate	See note 1	
4	10	Bolt M6	Stainless steel 316	

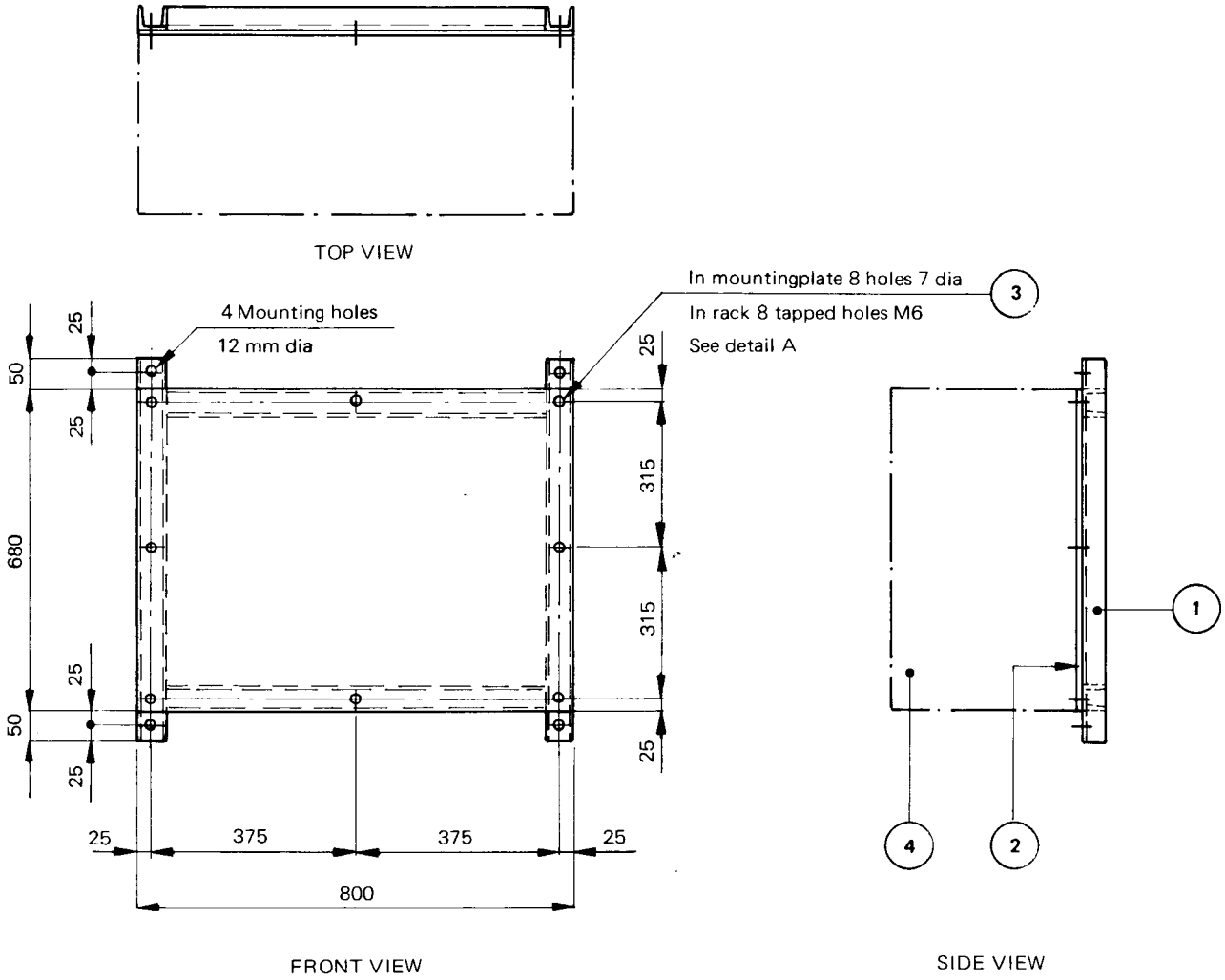
Engineering notes:

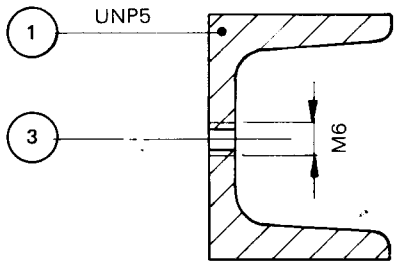
1. Rack and supports to be constructed from stainless steel 316 prefabricated U- or H profile.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

TYPICAL SAMPLE CONDITIONING RACK

(FLOOR MOUNTING TYPE, BOLTED VERSION)

TYPICAL SAMPLE CONDITIONING RACK
(FLOOR MOUNTING TYPE, BOLTED VERSION Cont'd)





DETAIL A

Item	Qty.	Description	Material	Remarks
1	1	Mounting frame UNP5	See note 1	
2	1	Mounting plate 680 x 800 x 3 mm	Stainless steel 316	
3	8	Bolt M6 x 25	Stainless steel 316	See detail A
4	1	Cabinet 660 x 800 x 400		

Engineering notes:

1. Rack and supports to be constructed from either stainless steel 316 or carbon steel which shall be hot dip galvanised to ASTM A123 or BS 729 after drilling and welding. After galvanizing the nuts shall be re-tapped.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

TYPICAL SAMPLE CONDITIONING RACK

(WALL MOUNTING TYPE, WELDED VERSION,)

APPENDIX 2 INDEX OF SAMPLE CONDITIONING SYSTEMS

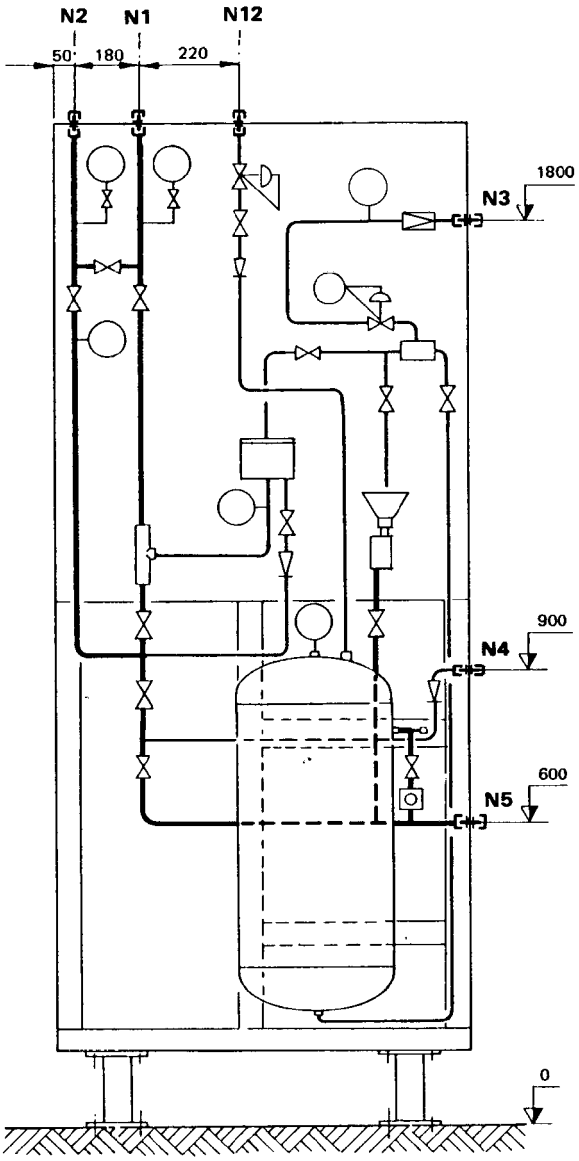
Typical liquid sample conditioning system for:

- CFPP distillation
- CFPP distillation with cooling of sample
- Chromatograph - single stream
- Chromatograph - multi stream
- Cloud point
- Cloud point with cooling of sample
- Colour
- Density with cooling
- Density with flushing
- Density with cooling and flushing
- Dissolved oxygen
- FBP and flash point
- FBP and flash point with cooling of sample
- Flash point with sample cooling/refrigeration
- Kinetic vapour pressure
- Oil in water
- pH and conductivity
- pH and conductivity with filter/coalescer
- Viscosity
- Water hardness

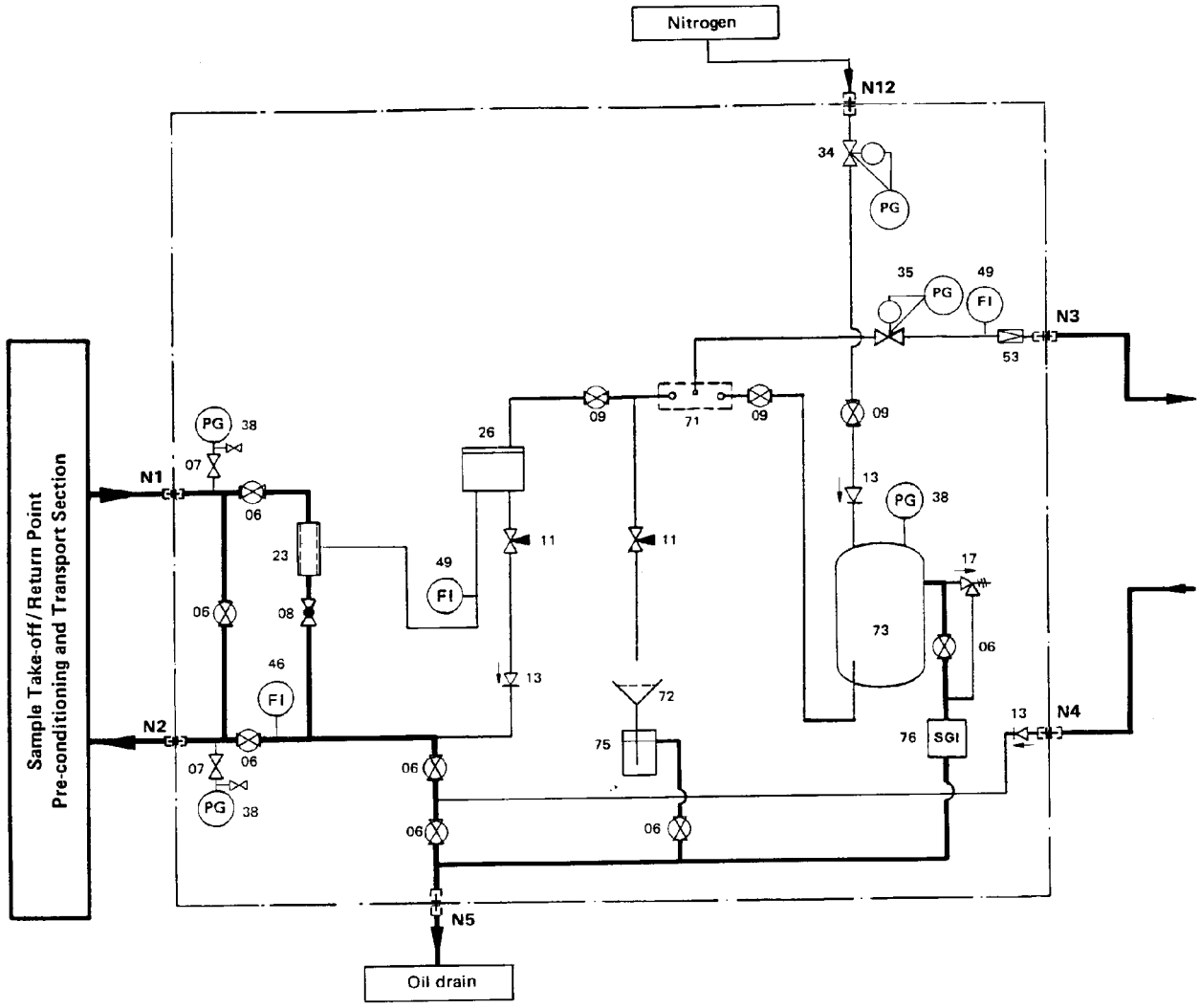
Typical gas sample conditioning system for:

- Chromatograph - single stream
- Chromatograph - multi stream
- Density
- Density (make Debro)
- Oxygen
- Oxygen (make Servomex)
- Oxygen (make Westinghouse)
- Thermal conductivity
- Water content

LIQUID SAMPLE CONDITIONING SYSTEM (cont'd)



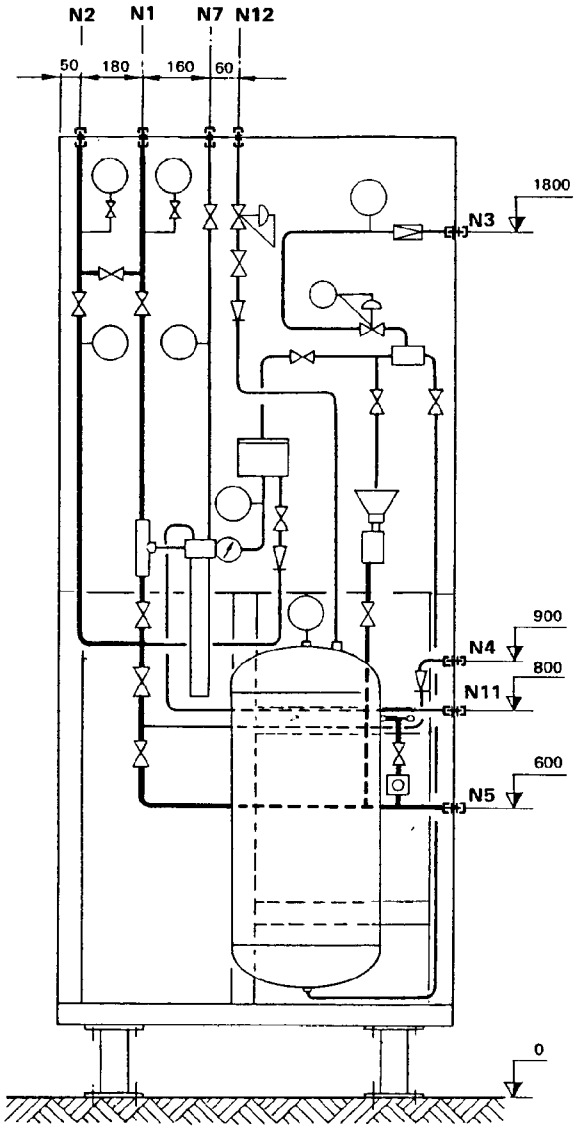
Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD



Engineering notes:

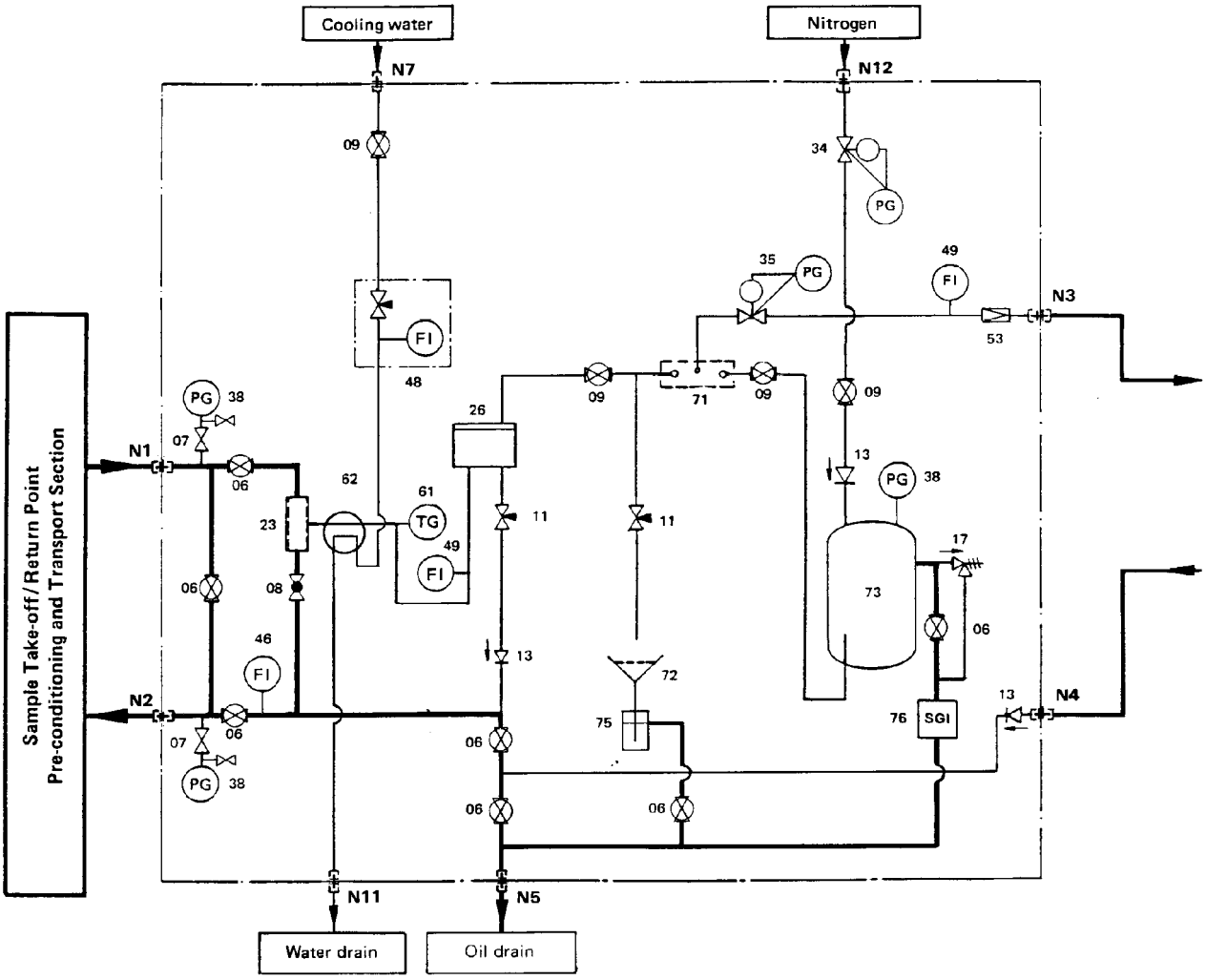
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(CFPP, DISTILLATION)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

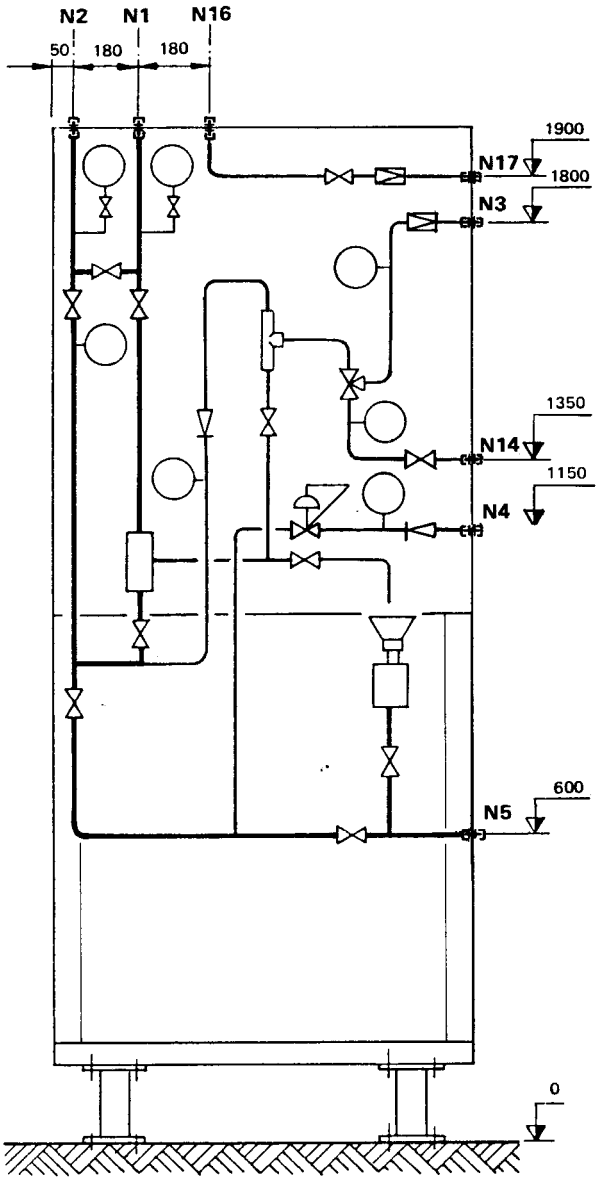
(CFPP, DISTILLATION, Cont'd)



Engineering notes:

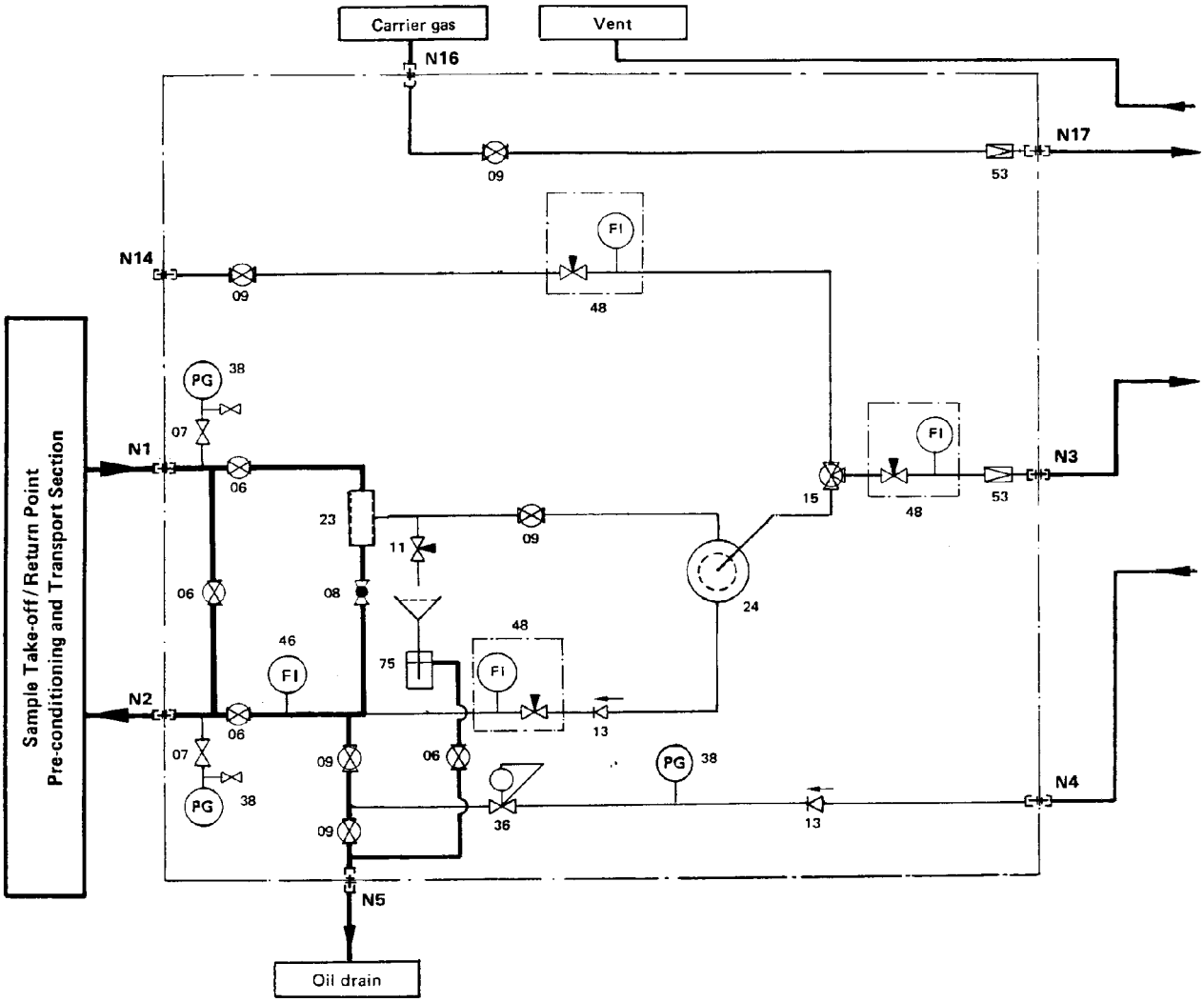
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(CFPP, DISTILLATION WITH COOLING OF SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample outlet to analyser	Bulkhead union	3 mm OD	1/8 in. OD
N4	Sample return from analyser	Bulkhead union	3 mm OD	1/8 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N14	Calibration sample	Bulkhead union	6 mm OD	1/4 in. OD
N16	Carrier gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Carrier gas outlet to analyser	Bulkhead union	6 mm OD	1/4 in. OD

(CFPP, DISTILLATION WITH COOLING OF SAMPLE, Cont'd.)

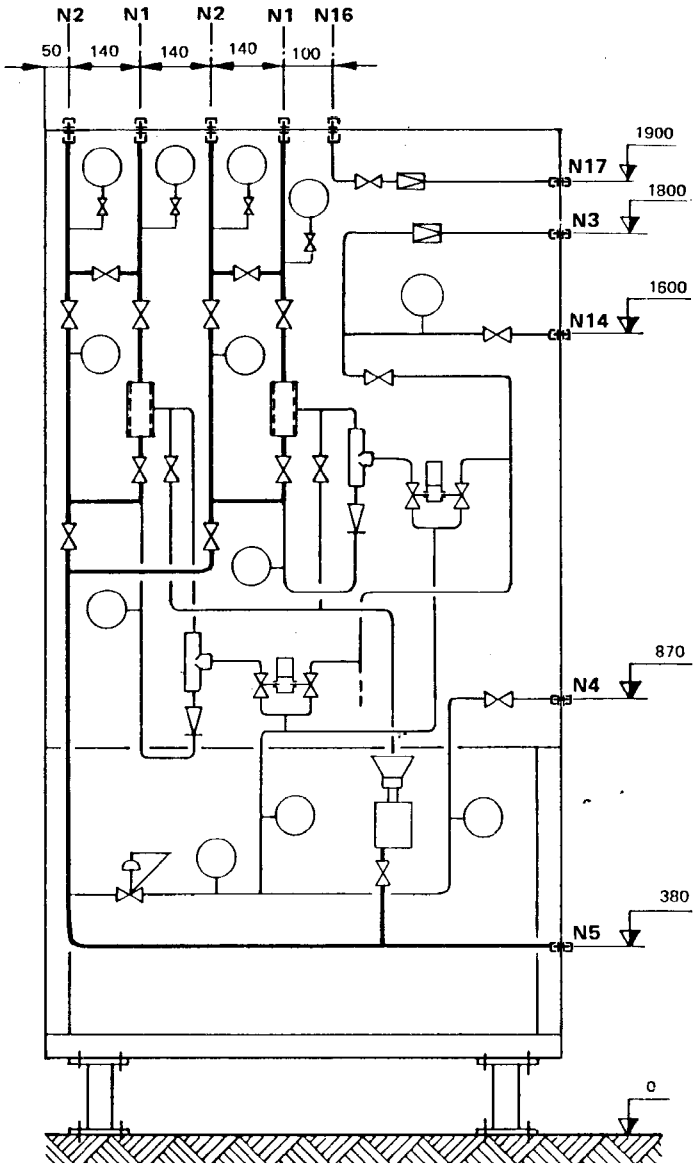


Engineering notes:

1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

SINGLE STREAM

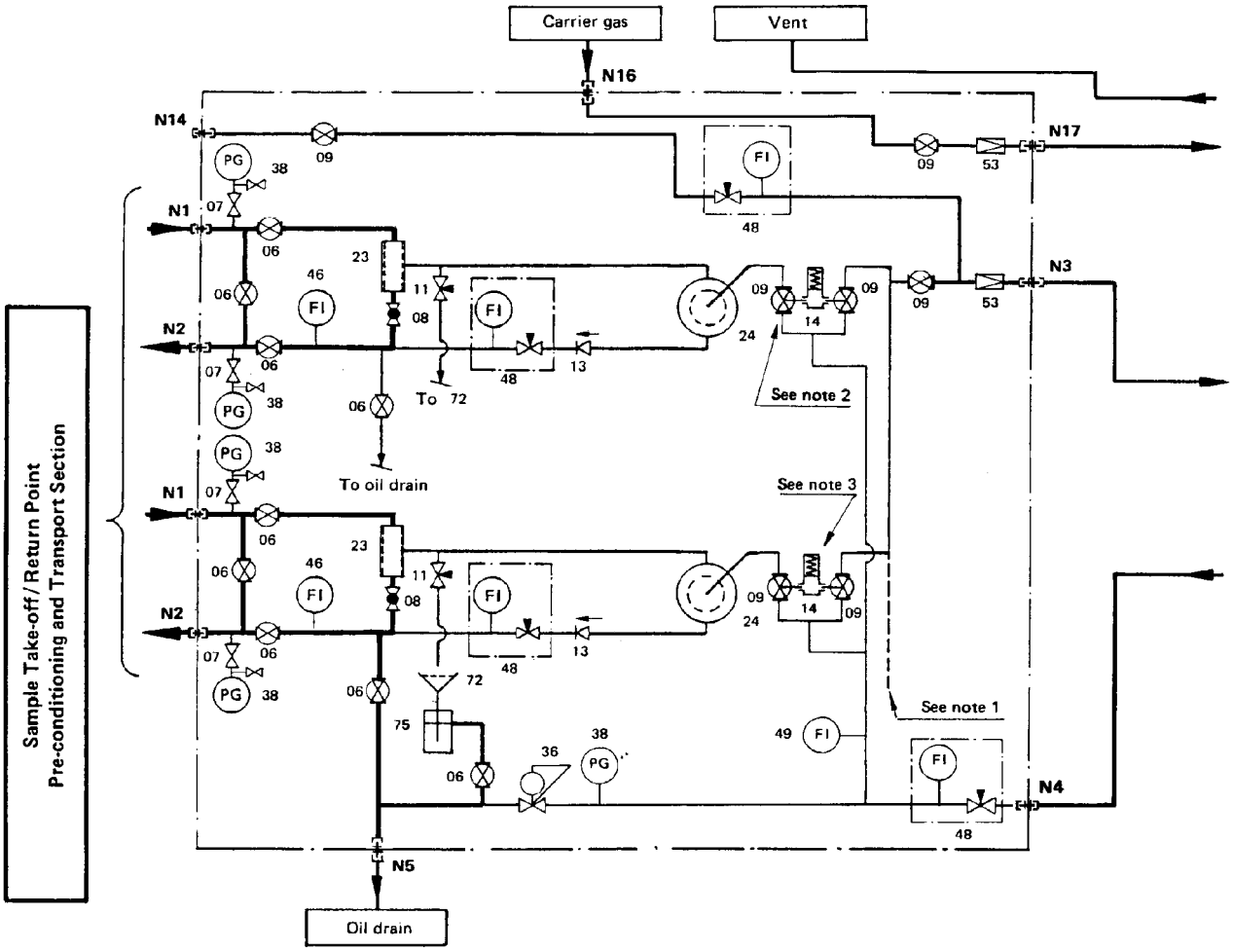
(CHROMATOGRAPH, LIQUID SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N14	Calibration sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N16	Carrier gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Carrier gas to analyser	Bulkhead union	6 mm OD	1/4 in. OD

SINGLE STREAM

(CHROMATOGRAPH, LIQUID SAMPLE, Cont'd.)

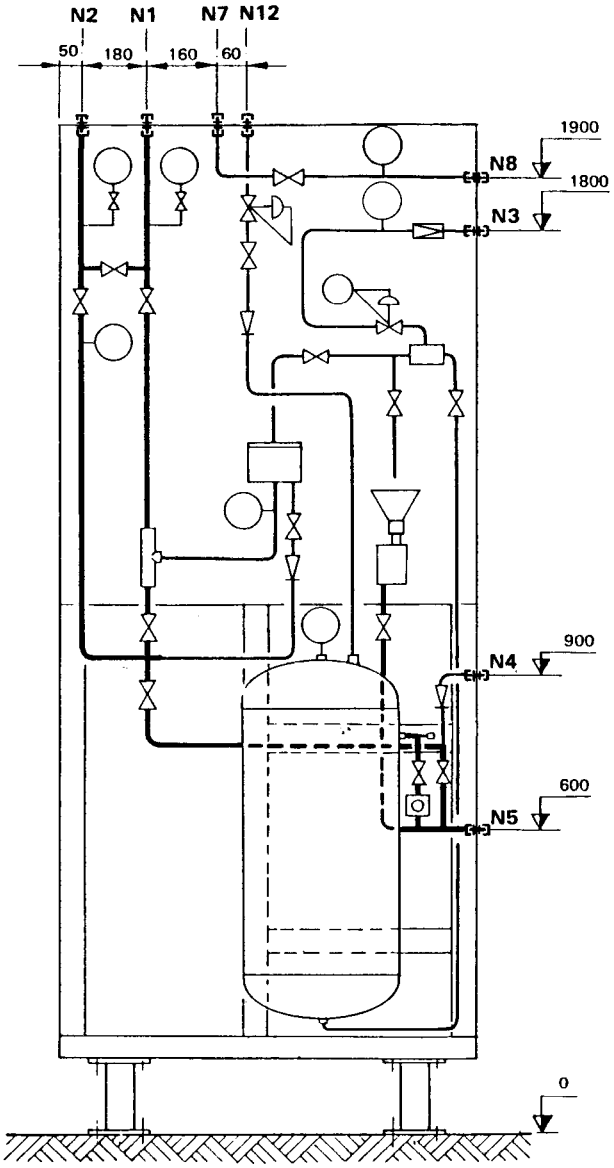


Engineering notes:

1. For number of sample streams, see requisition.
2. Two ball valves operated by one pneumatic actuator.
3. Pneumatic operated valves to be operated by solenoid valves from stream selector of process chromatograph.
4. For description of numbered items see appendix 7.
5. Dimensions and lay-out are typical.
6. Dimensions in millimetres, unless otherwise stated.

MULTI STREAM

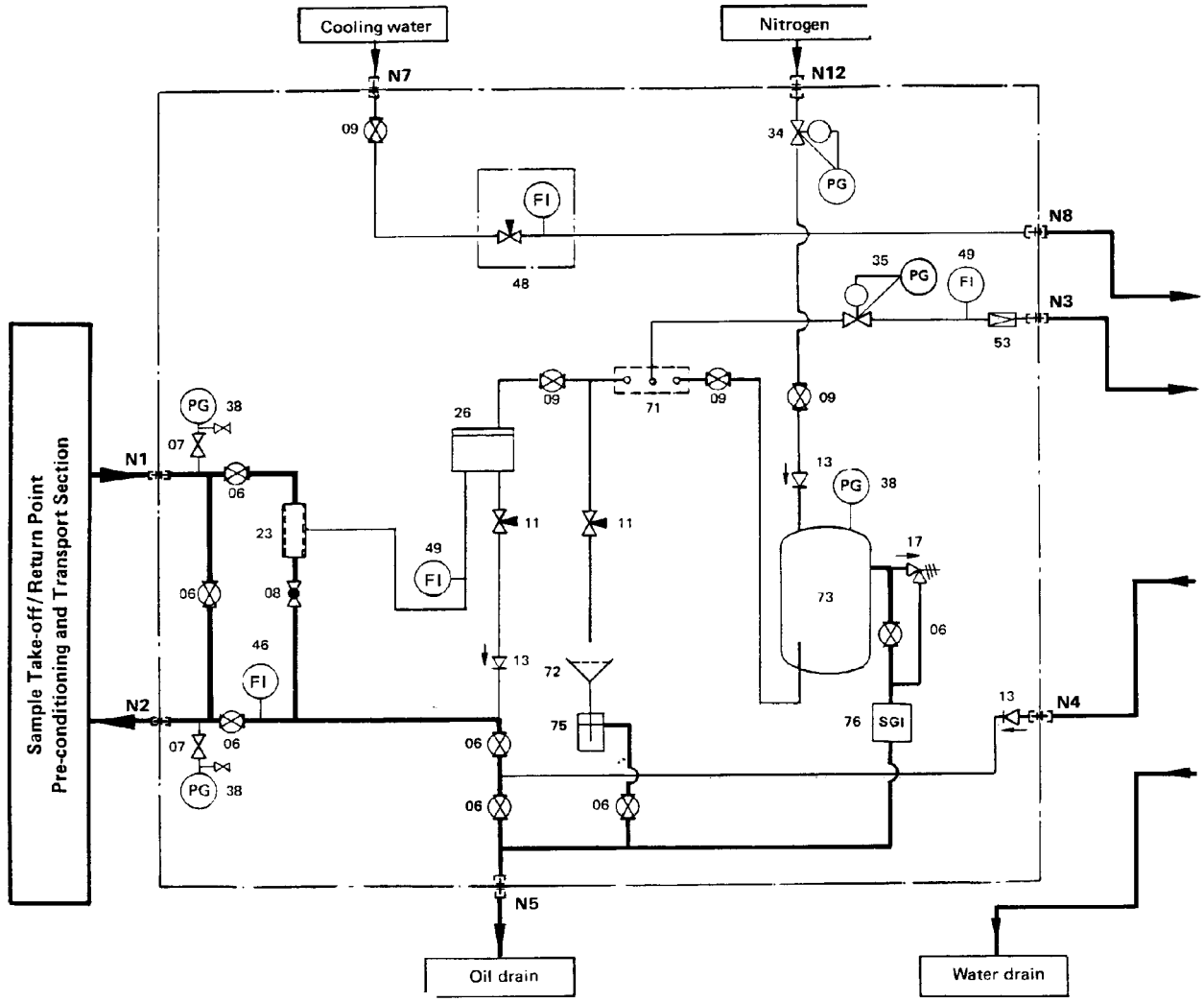
(CHROMATOGRAPH LIQUID SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N8	Cooling water to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

MULTI STREAM

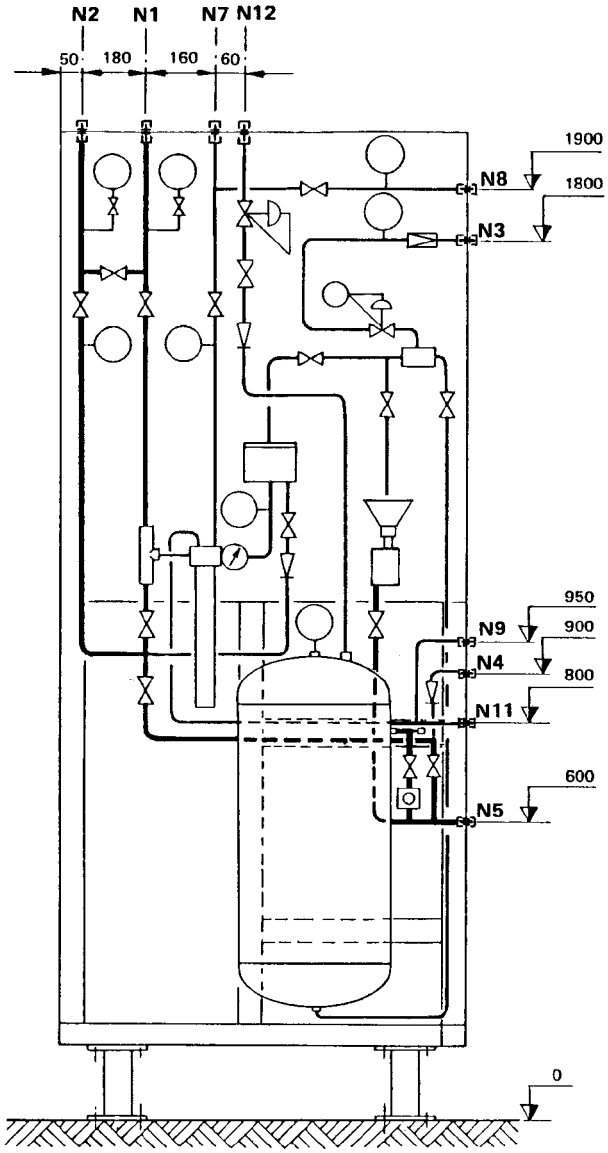
(CHROMATOGRAPH LIQUID SAMPLE, Cont'd)



Engineering notes:

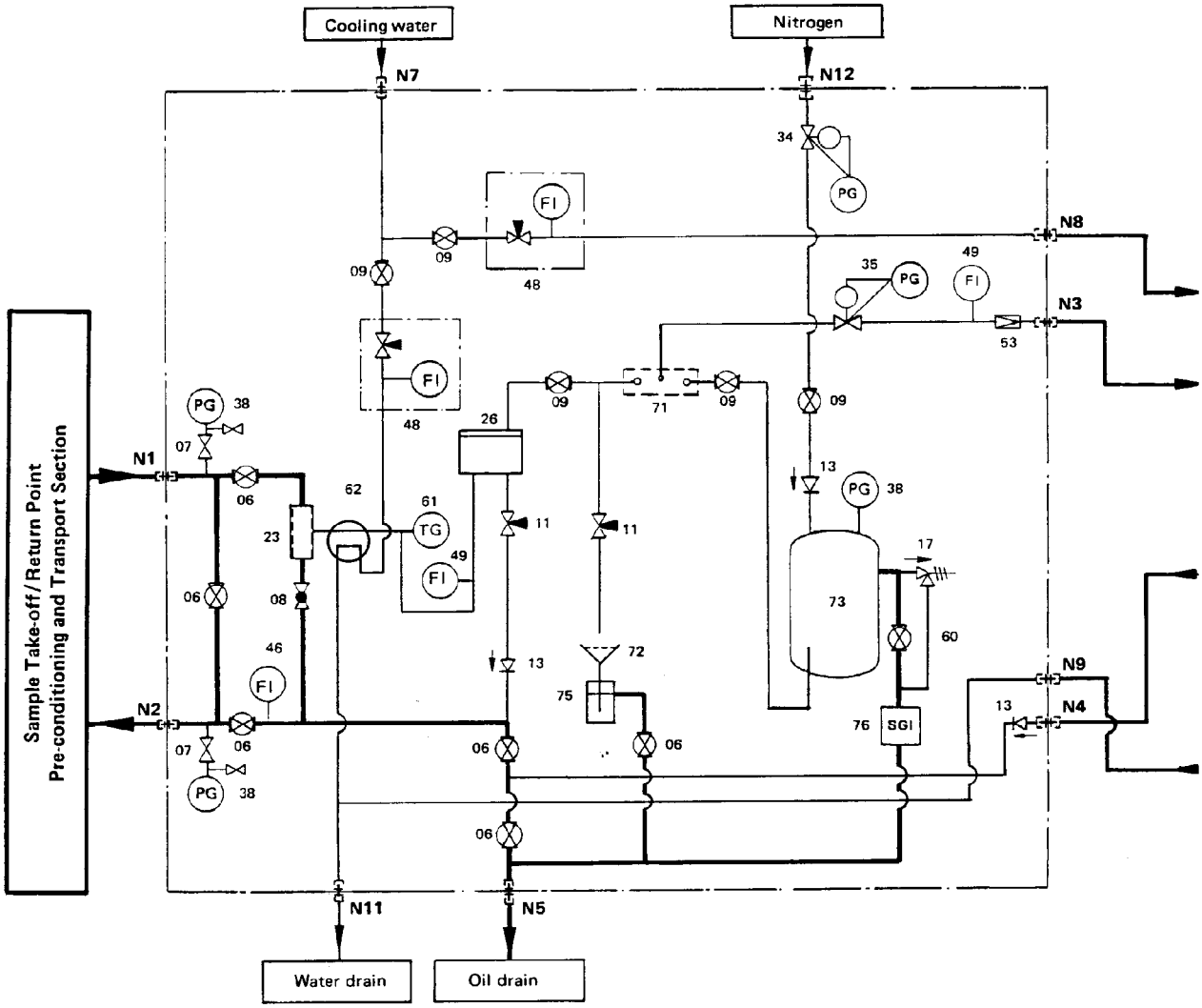
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(CLOUD POINT)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	12 mm OD	1/2 in. OD
N8	Cooling water to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N9	Cooling water return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

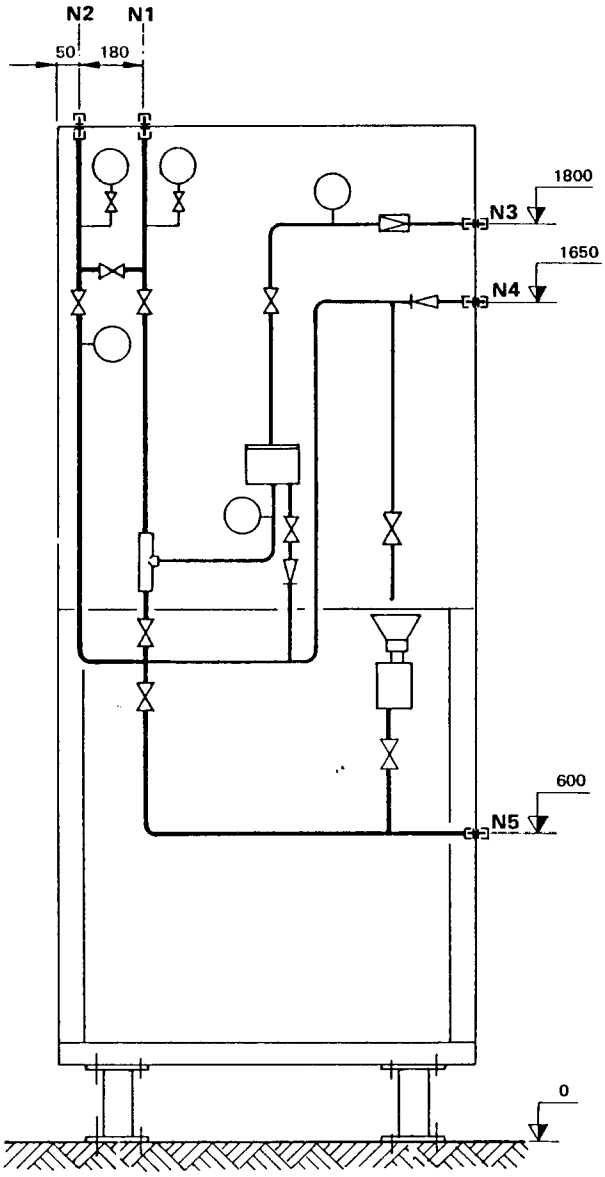
(CLOUD POINT, Cont'd)



Engineering notes:

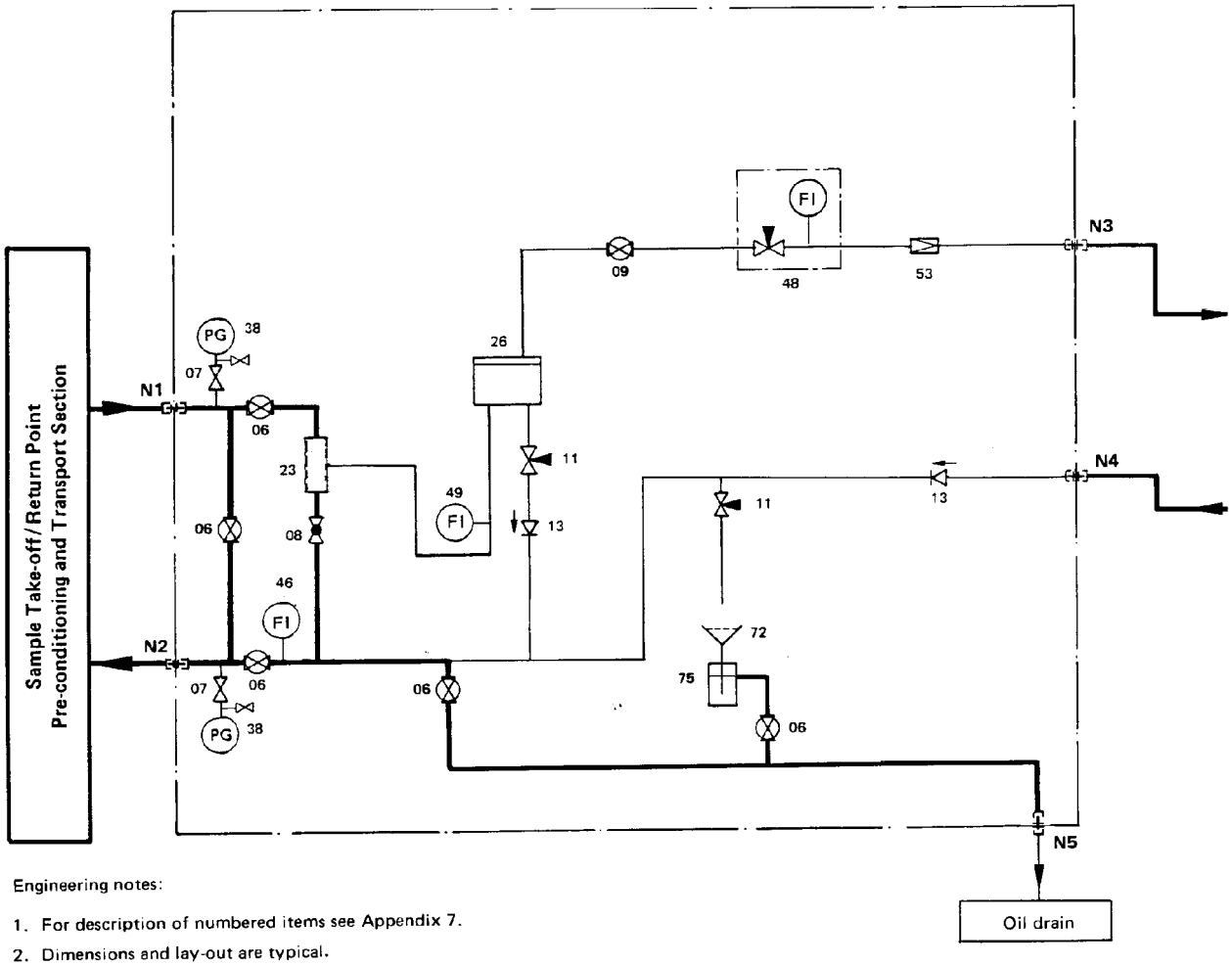
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(CLOUD POINT WITH COOLING OF SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD

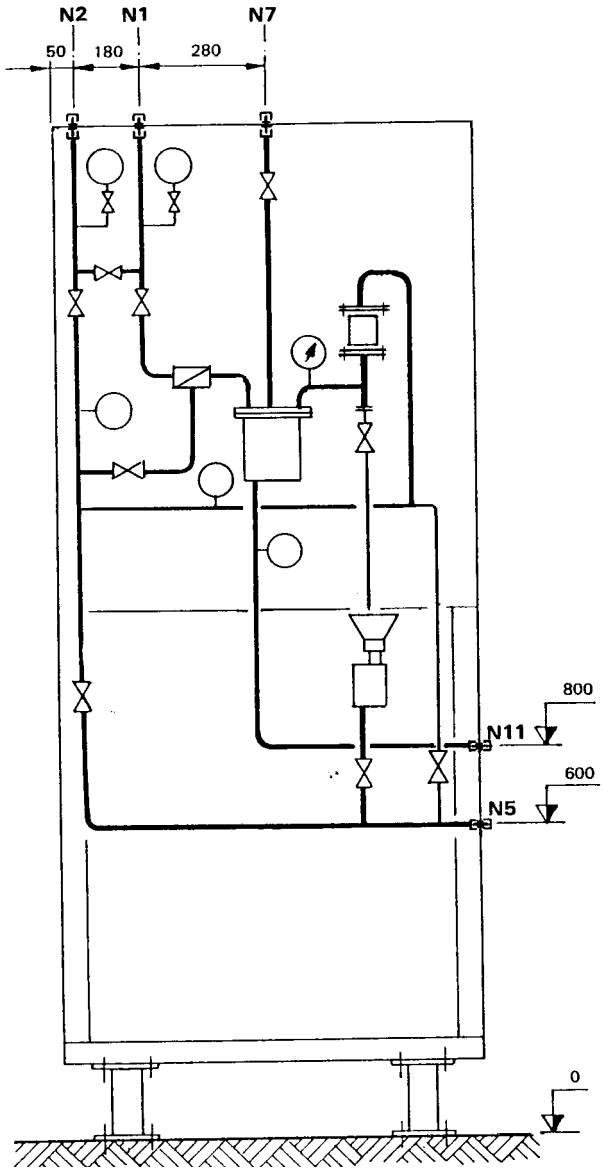
(CLOUD POINT WITH COOLING OF SAMPLE, Cont'd)



Engineering notes:

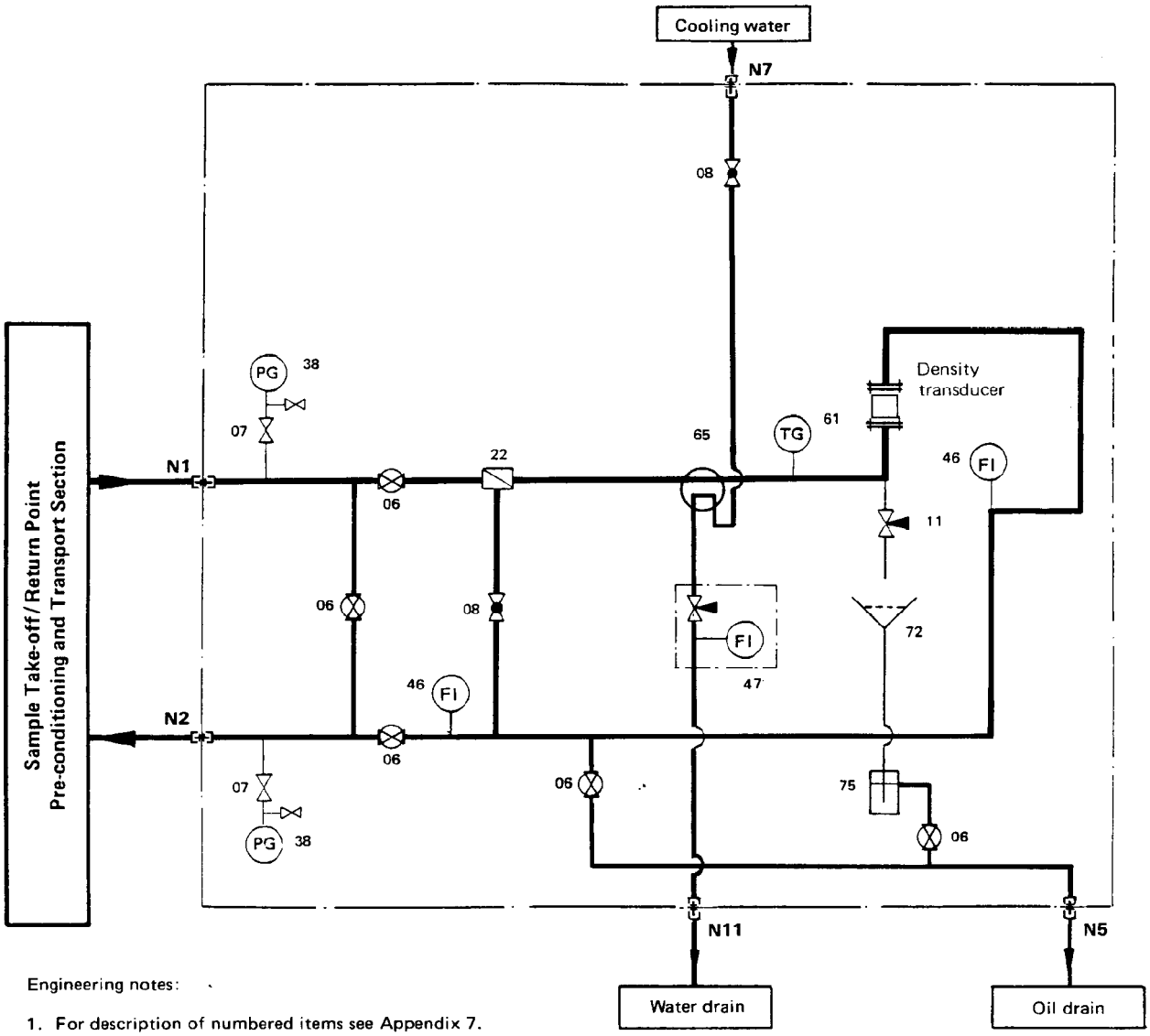
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(COLOUR)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	12 mm OD	1/2 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD

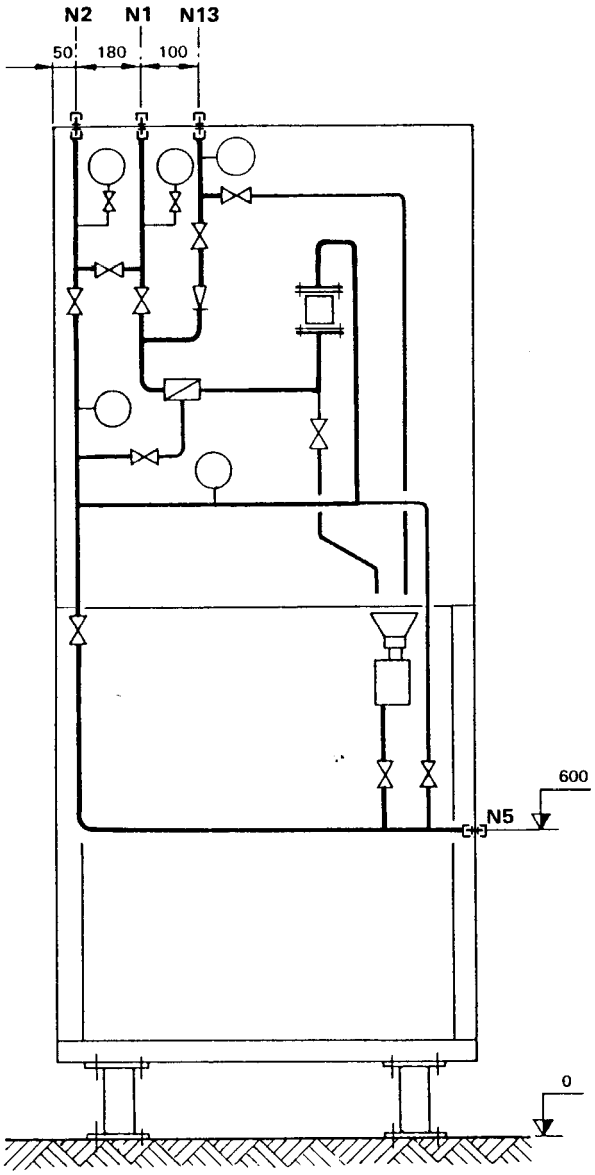
(COLOUR, Cont'd)



Engineering notes:

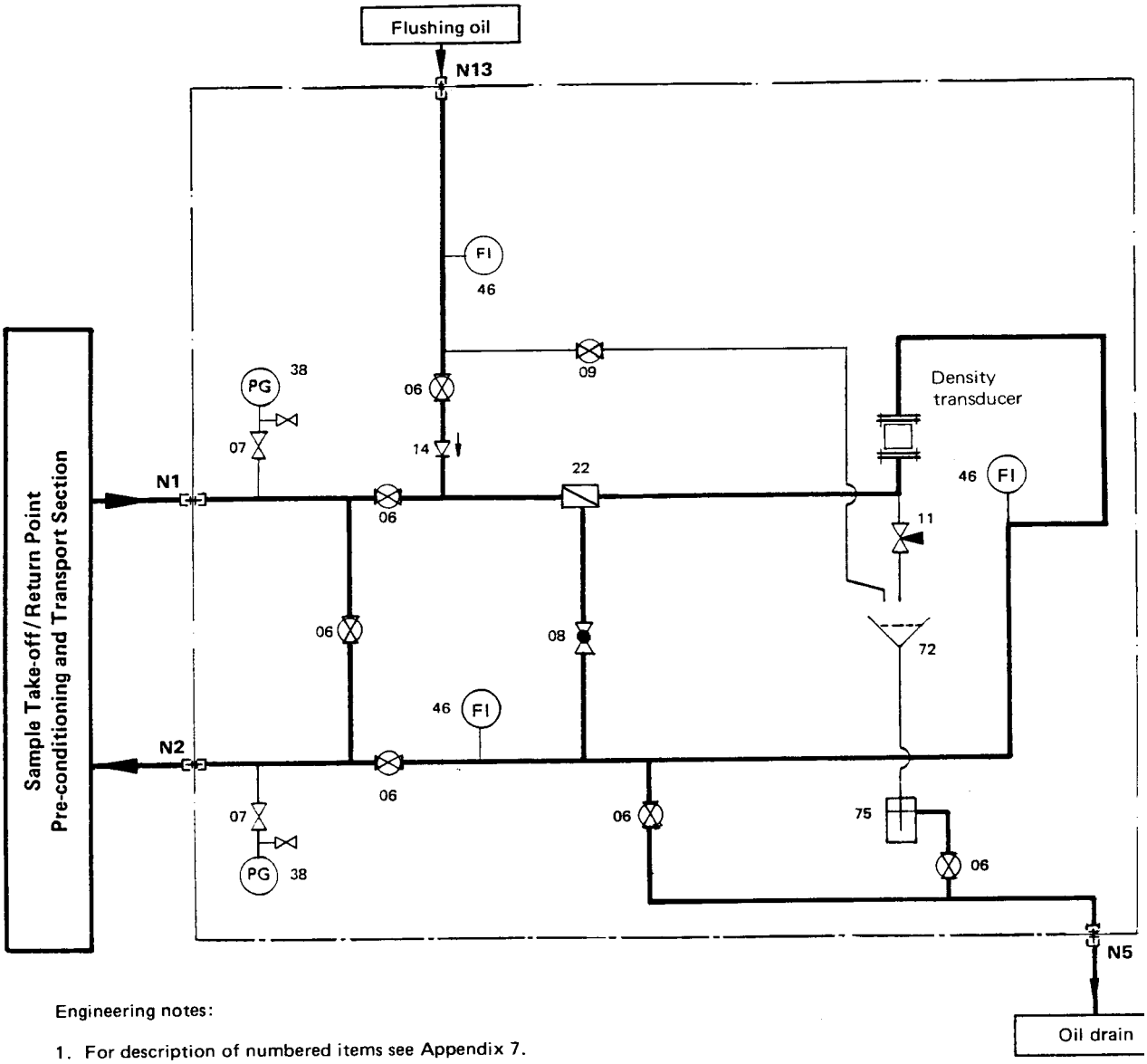
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DENSITY - LIQUID COOLING)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N13	Flushing oil inlet	Bulkhead union	12 mm OD	1/2 in. OD

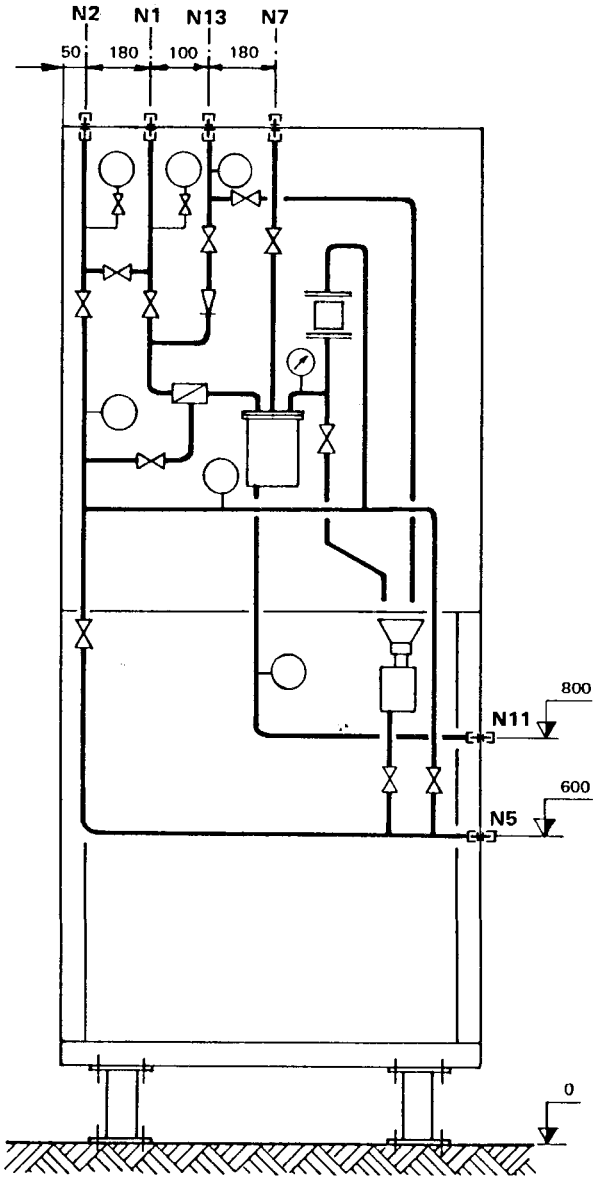
(DENSITY - LIQUID COOLING, Cont'd)



Engineering notes:

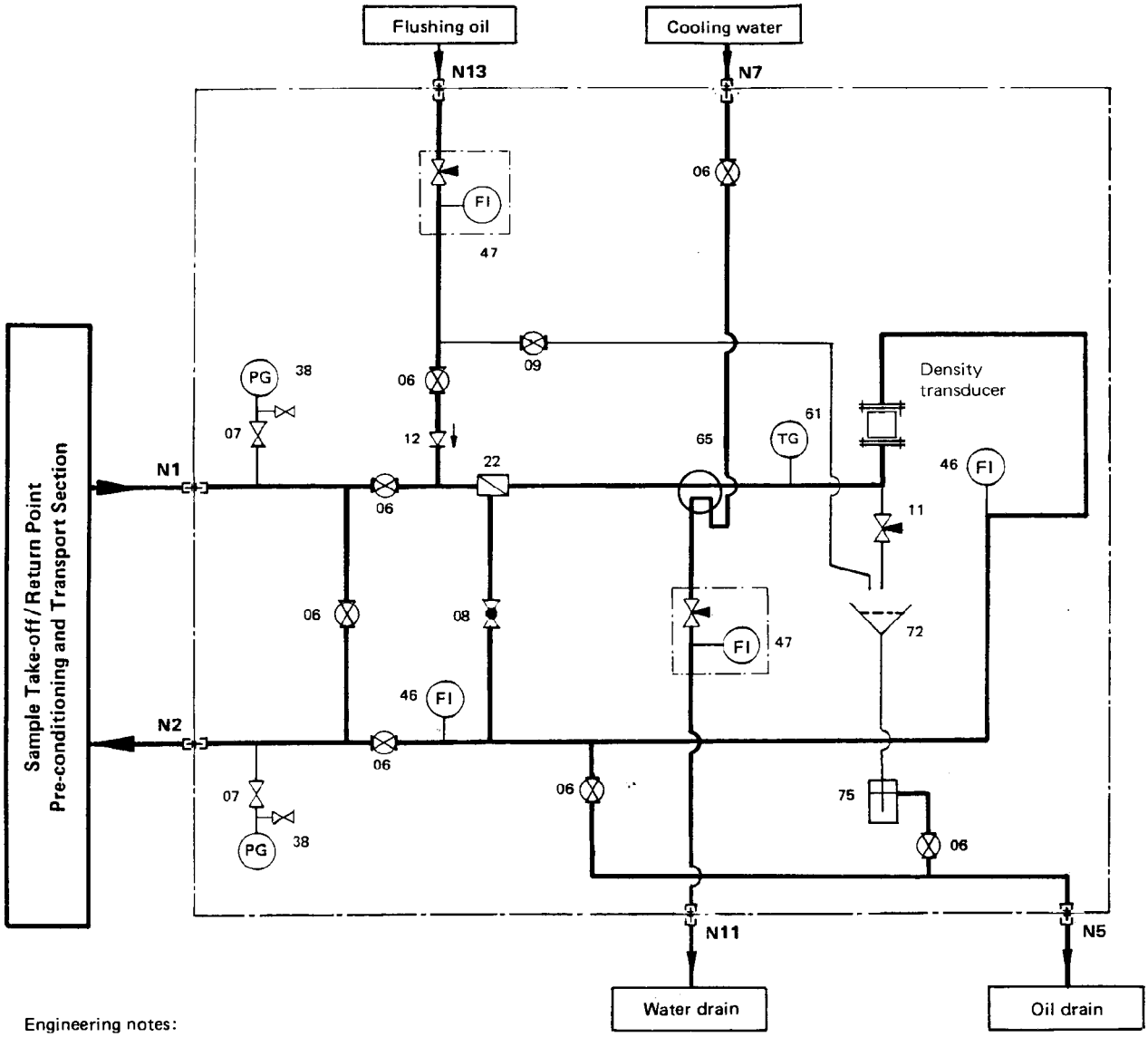
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DENSITY - LIQUID WITH FLUSHING)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	12 mm OD	1/2 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD
N13	Flushing oil inlet	Bulkhead union	12 mm OD	1/2 in. OD

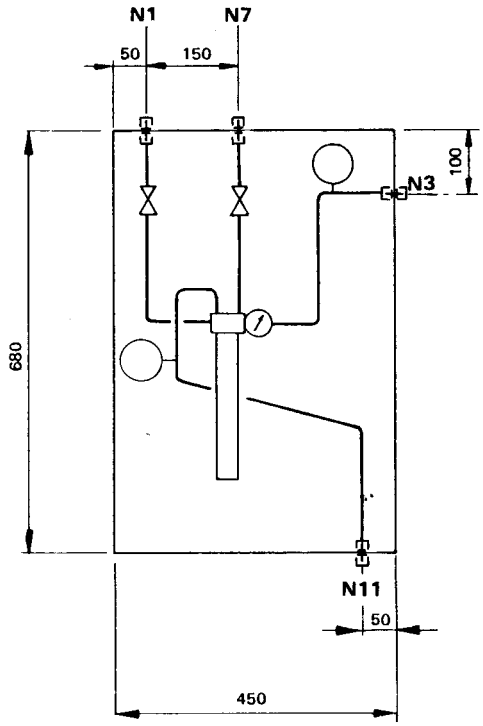
(DENSITY - LIQUID WITH FLUSHING, Cont'd)



Engineering notes:

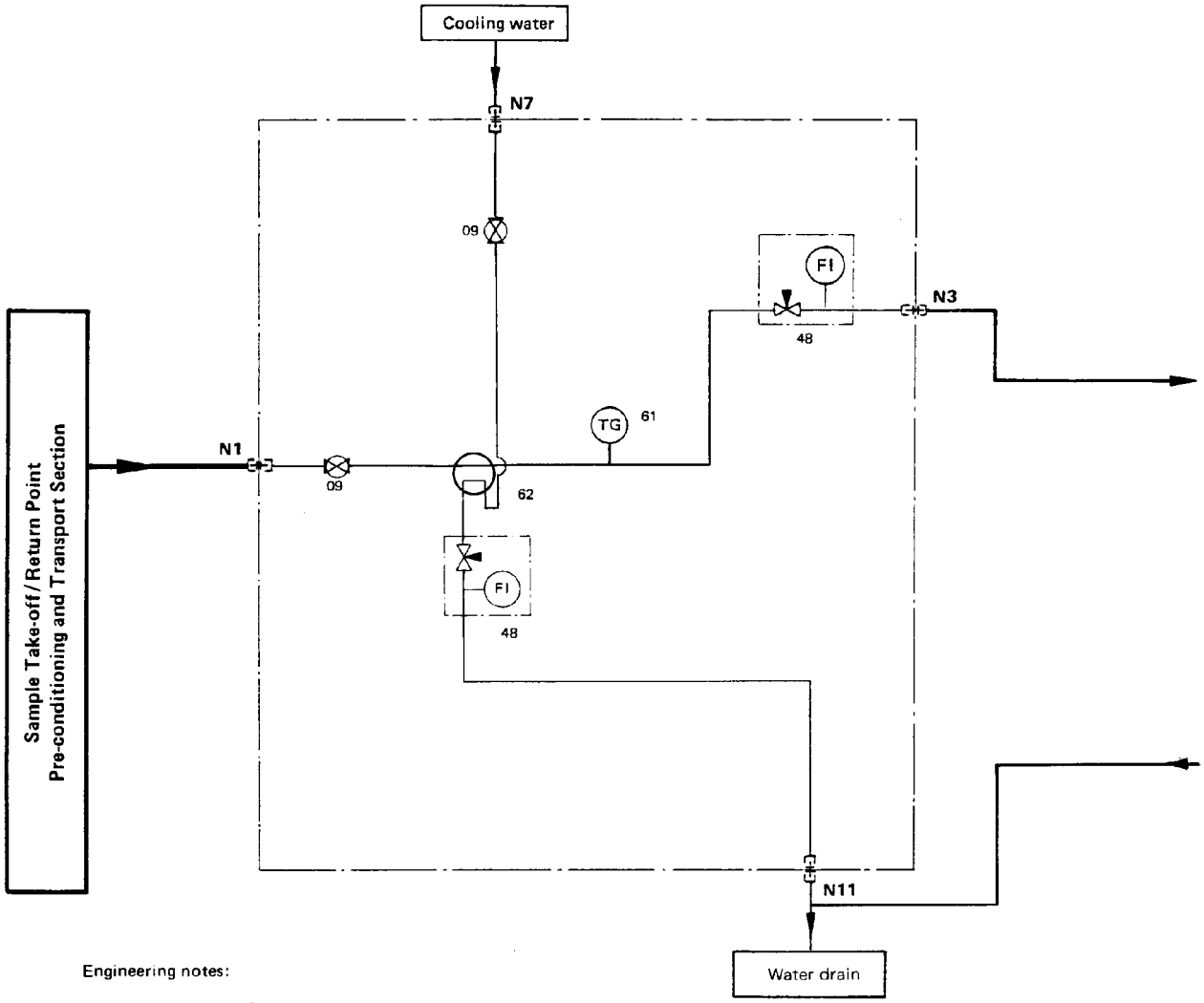
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DENSITY - LIQUID WITH COOLING AND FLUSHING)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD

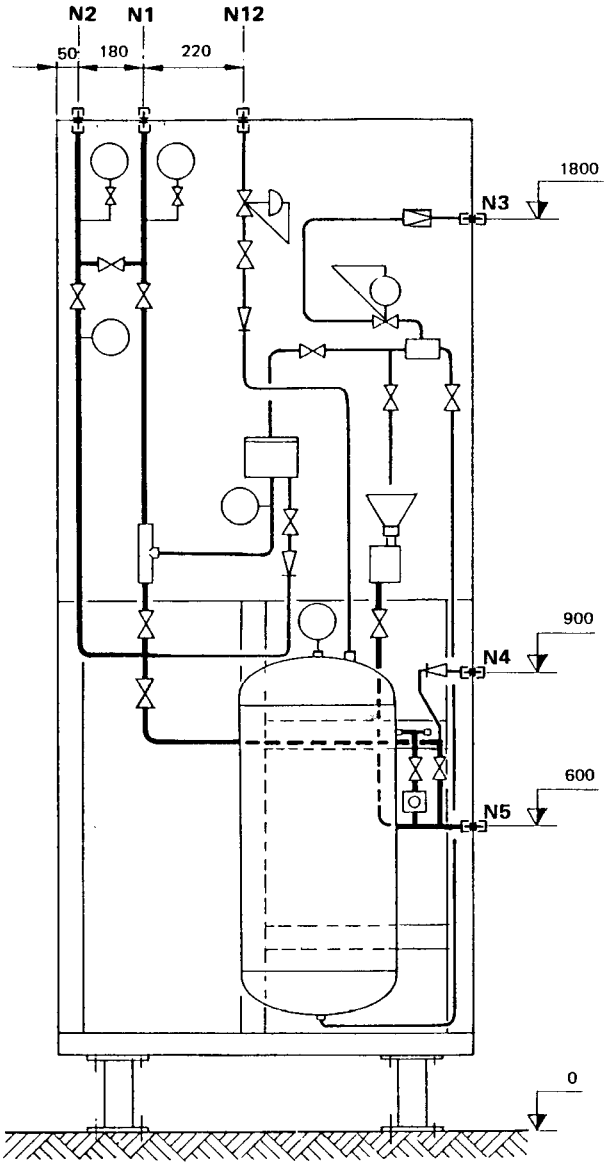
(DENSITY - LIQUID WITH COOLING AND FLUSHING, Cont'd)



Engineering notes:

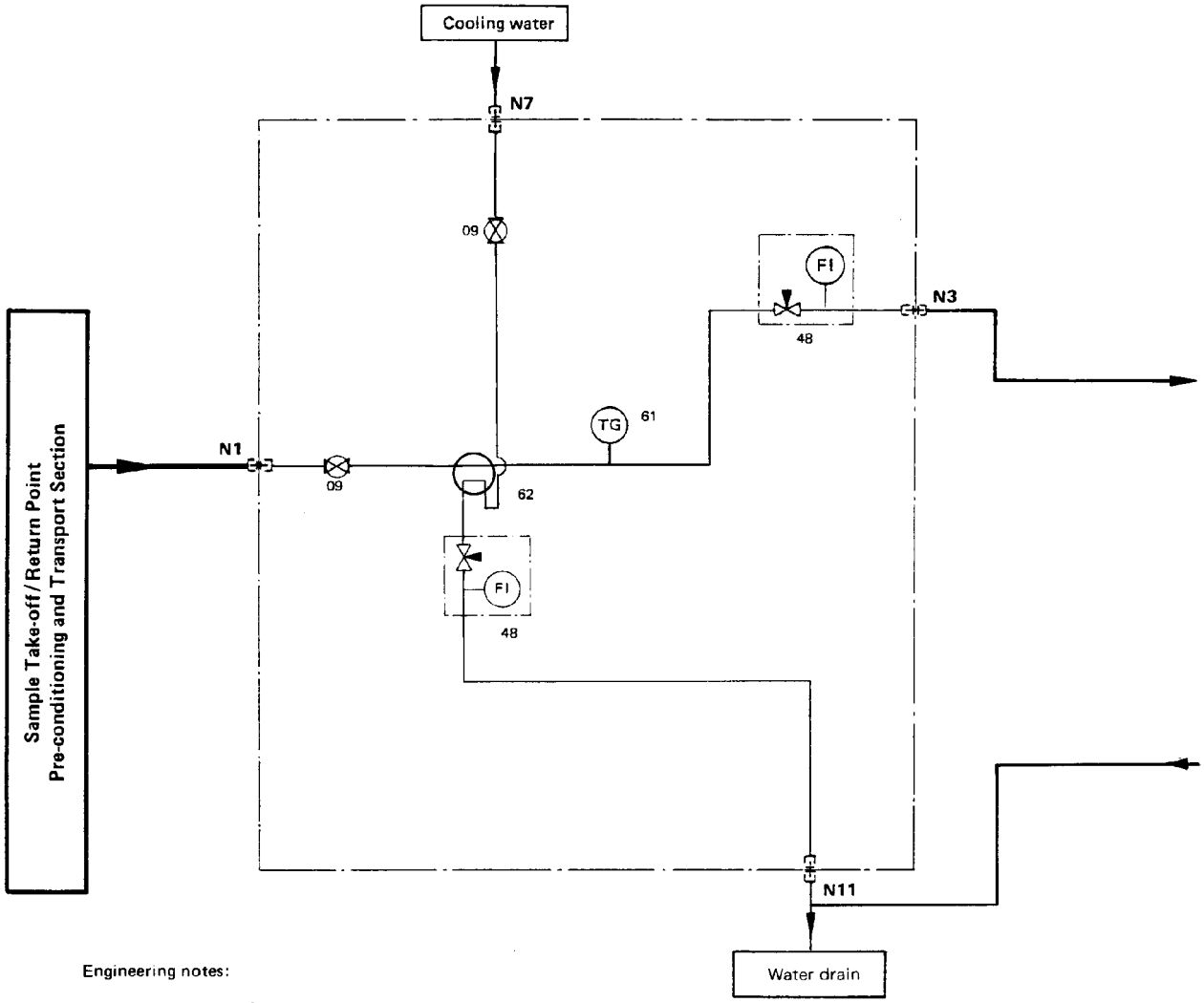
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DISSOLVED OXYGEN)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

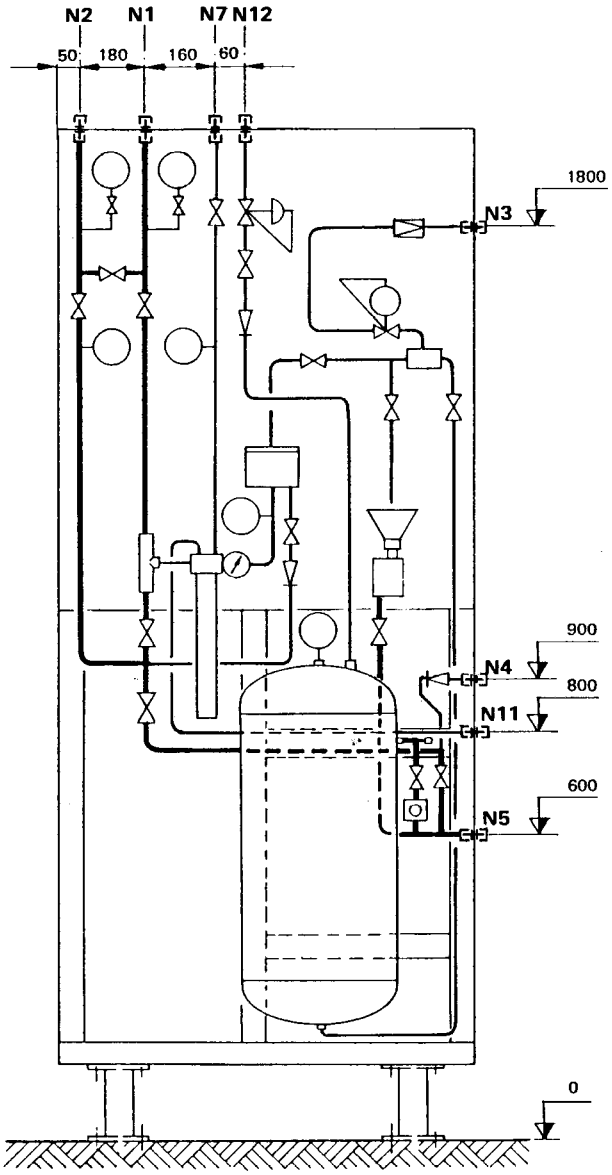
(DISSOLVED OXYGEN, Cont'd)



Engineering notes:

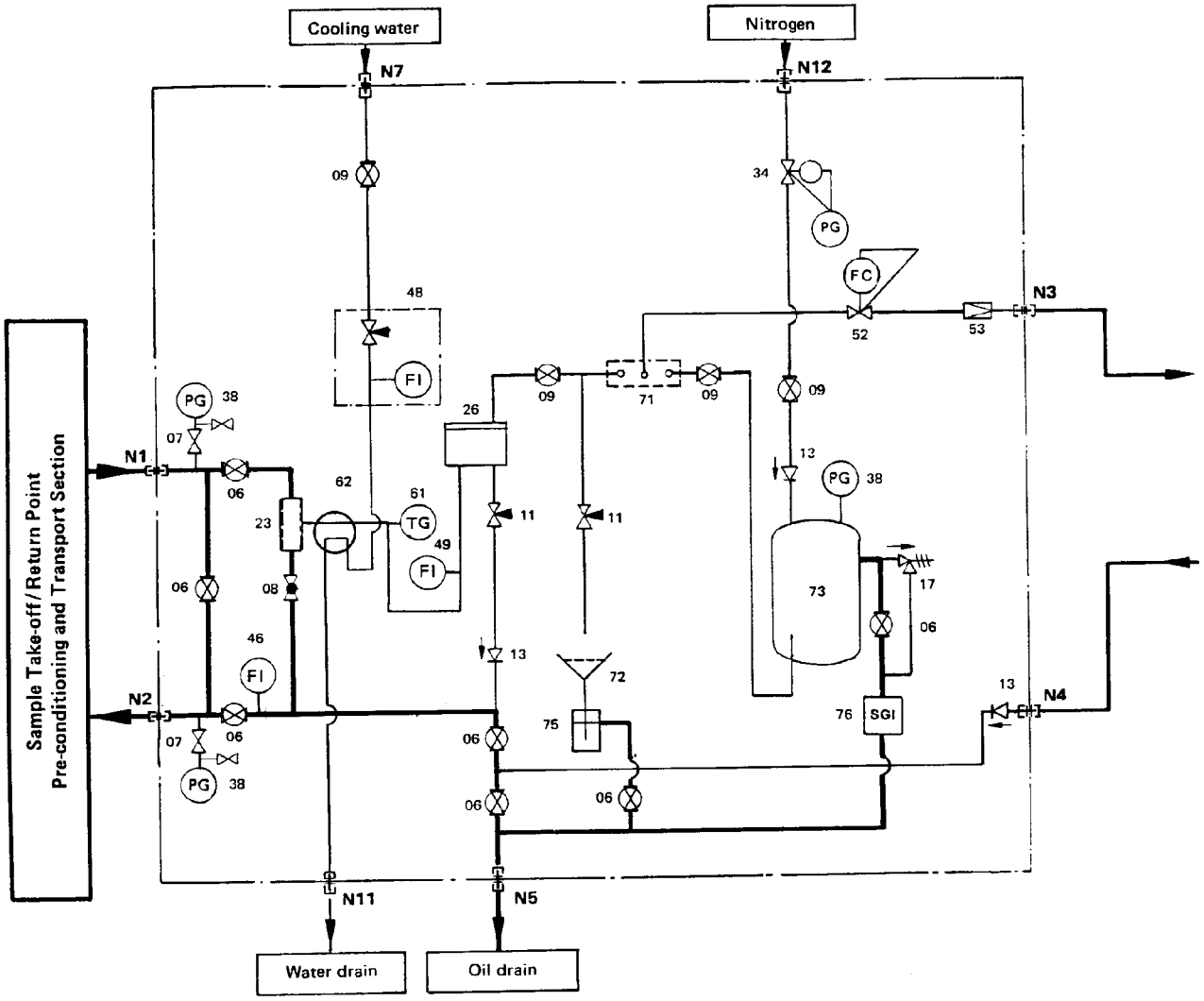
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DISTILLATION - FBP, FLASH POINT)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

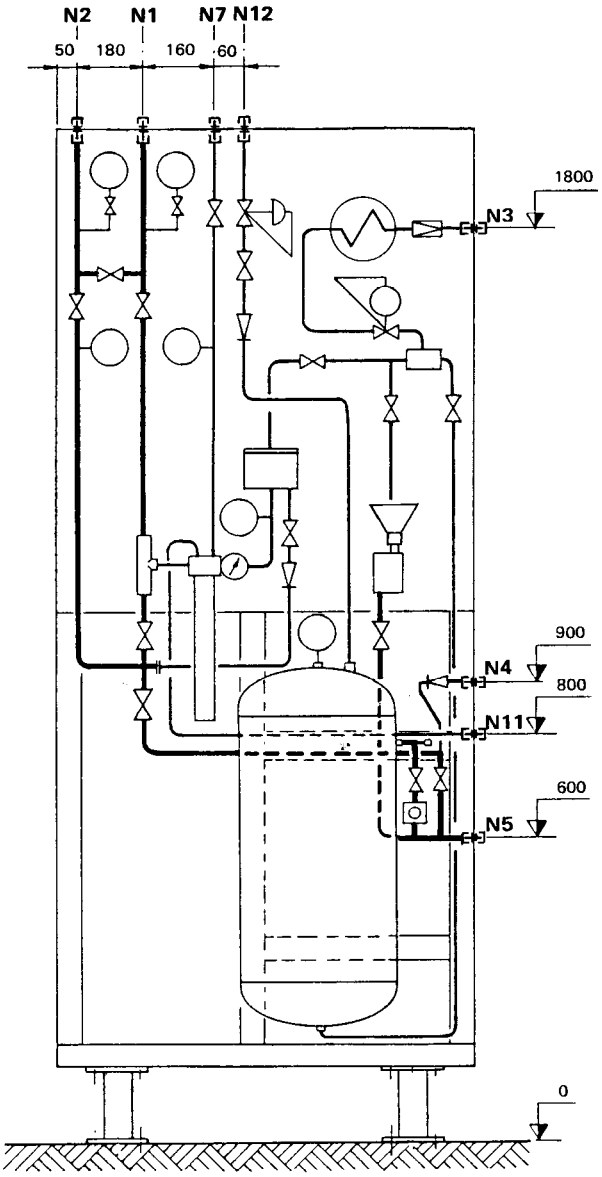
(DISTILLATION - FBP, FLASH POINT,Cont'd)



Engineering notes:

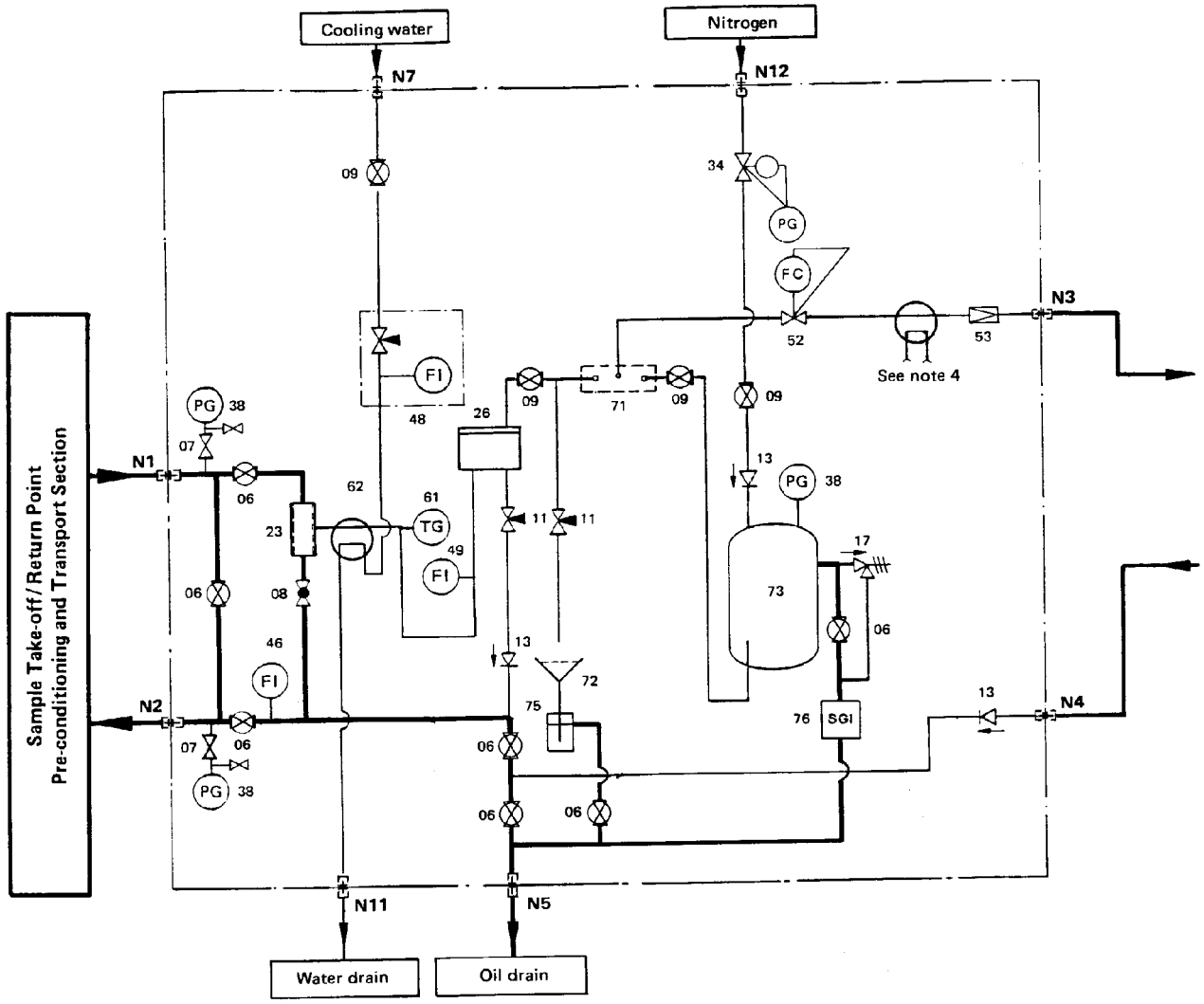
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DISTILLATION - FBP, FLASH POINT WITH COOLING OF SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD

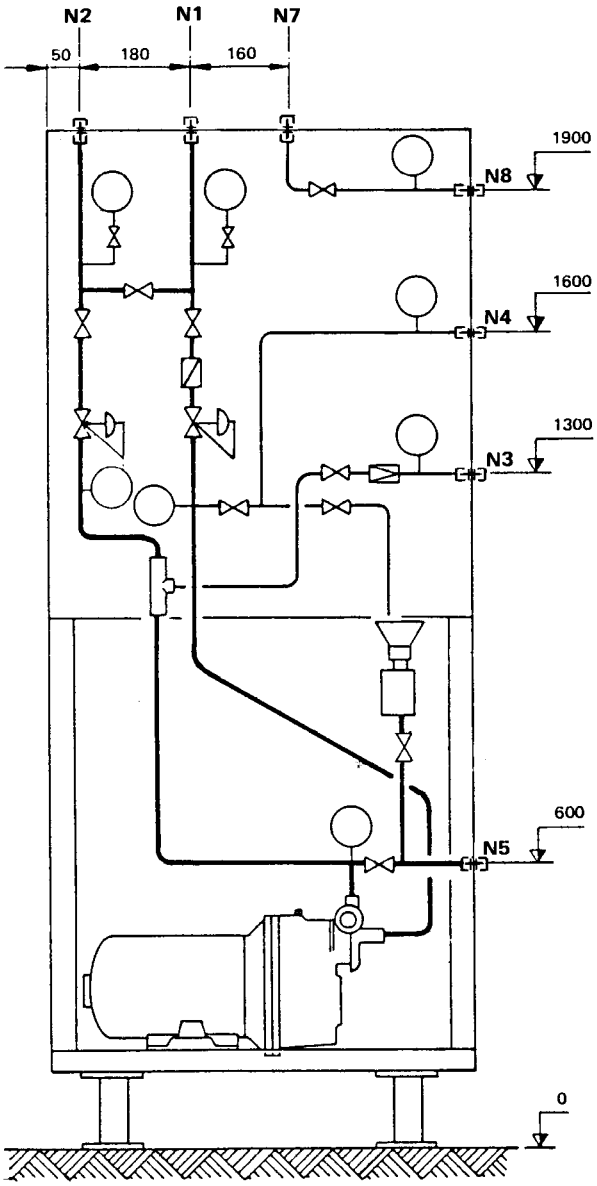
(DISTILLATION - FBP, FLASH POINT WITH COOLING OF SAMPLE, Cont'd)



Engineering notes:

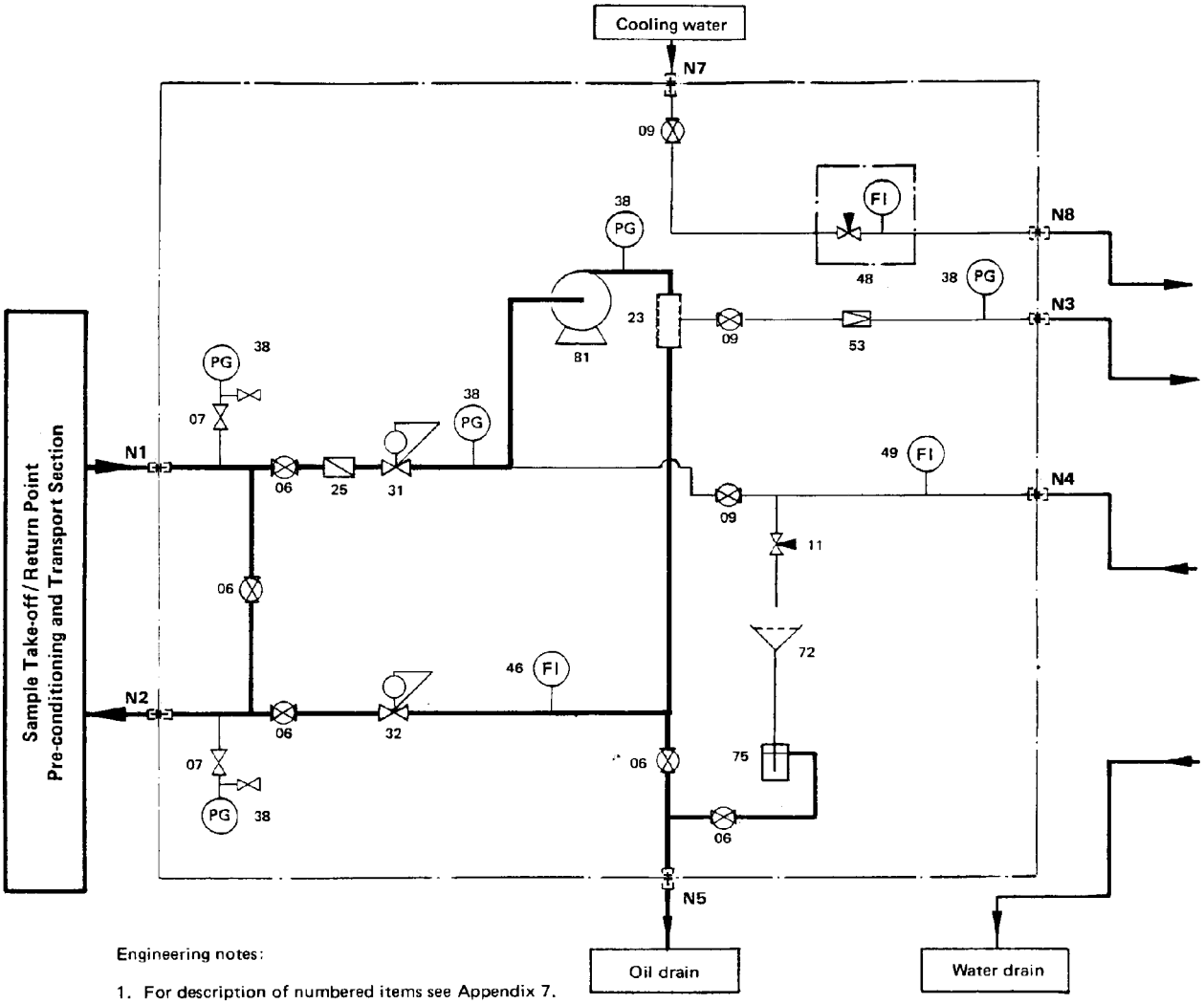
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.
4. Cooling medium from and to refrigerator.

(FLASH POINT WITH SAMPLE COOLER REFRIGERATOR)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N8	Cooling water to analyser	Bulkhead union	6 mm OD	1/4 in. OD

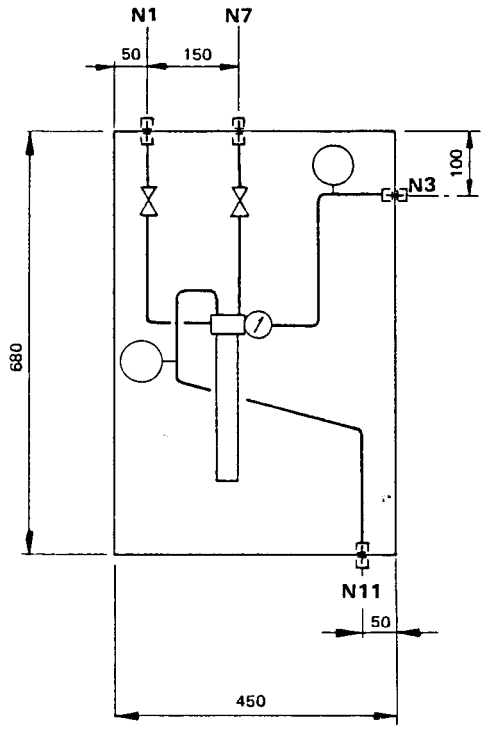
(FLASH POINT WITH SAMPLE COOLER REFRIGERATOR, Cont'd)



Engineering notes:

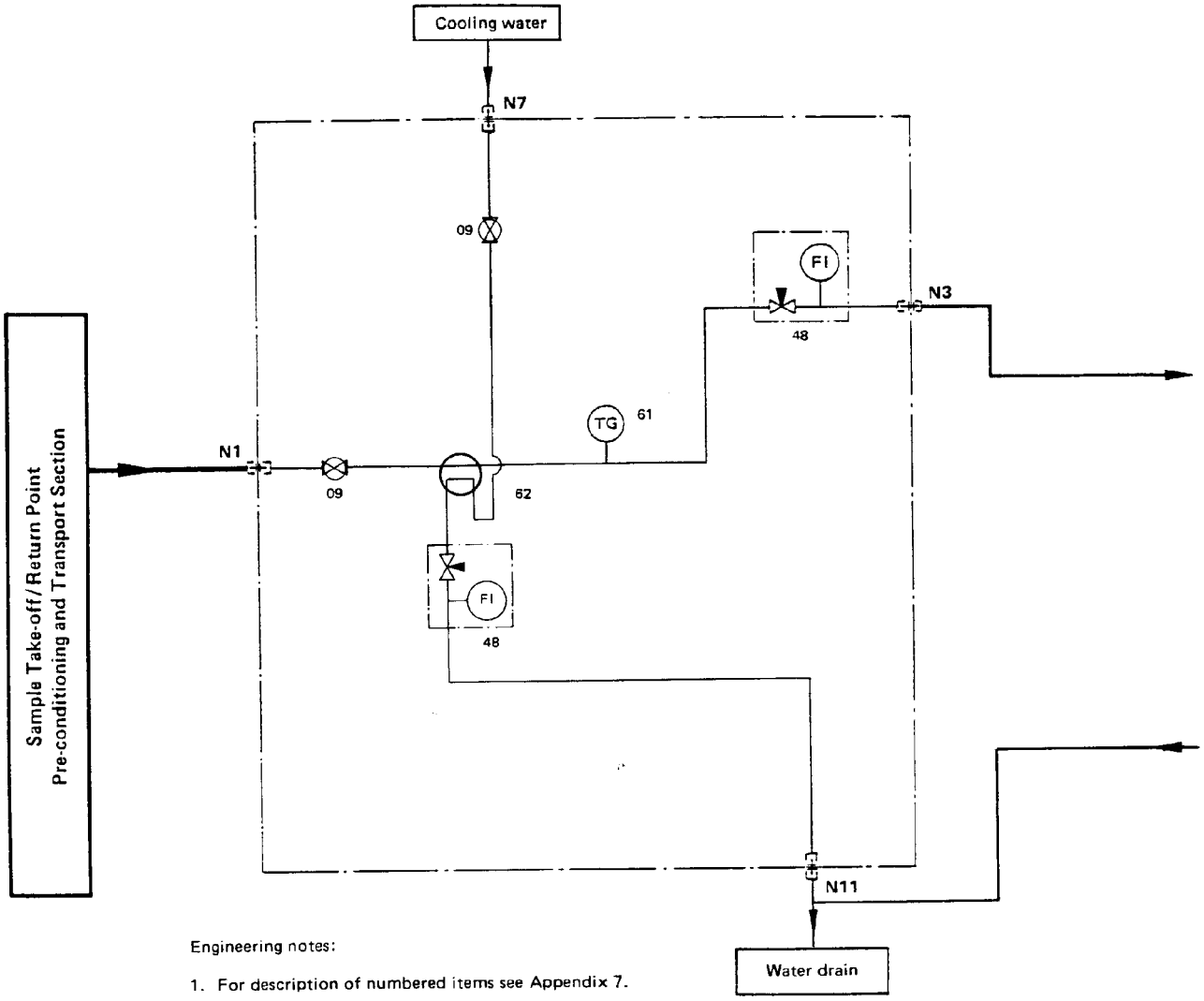
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(KINETIC VAPOUR PRESSURE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD

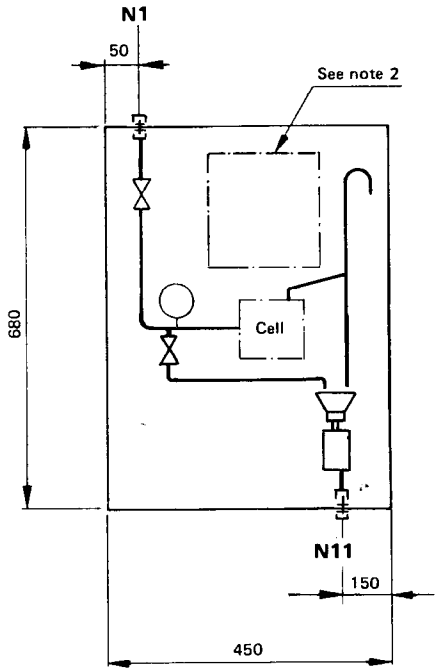
(KINETIC VAPOUR PRESSURE, Cont"d)



Engineering notes:

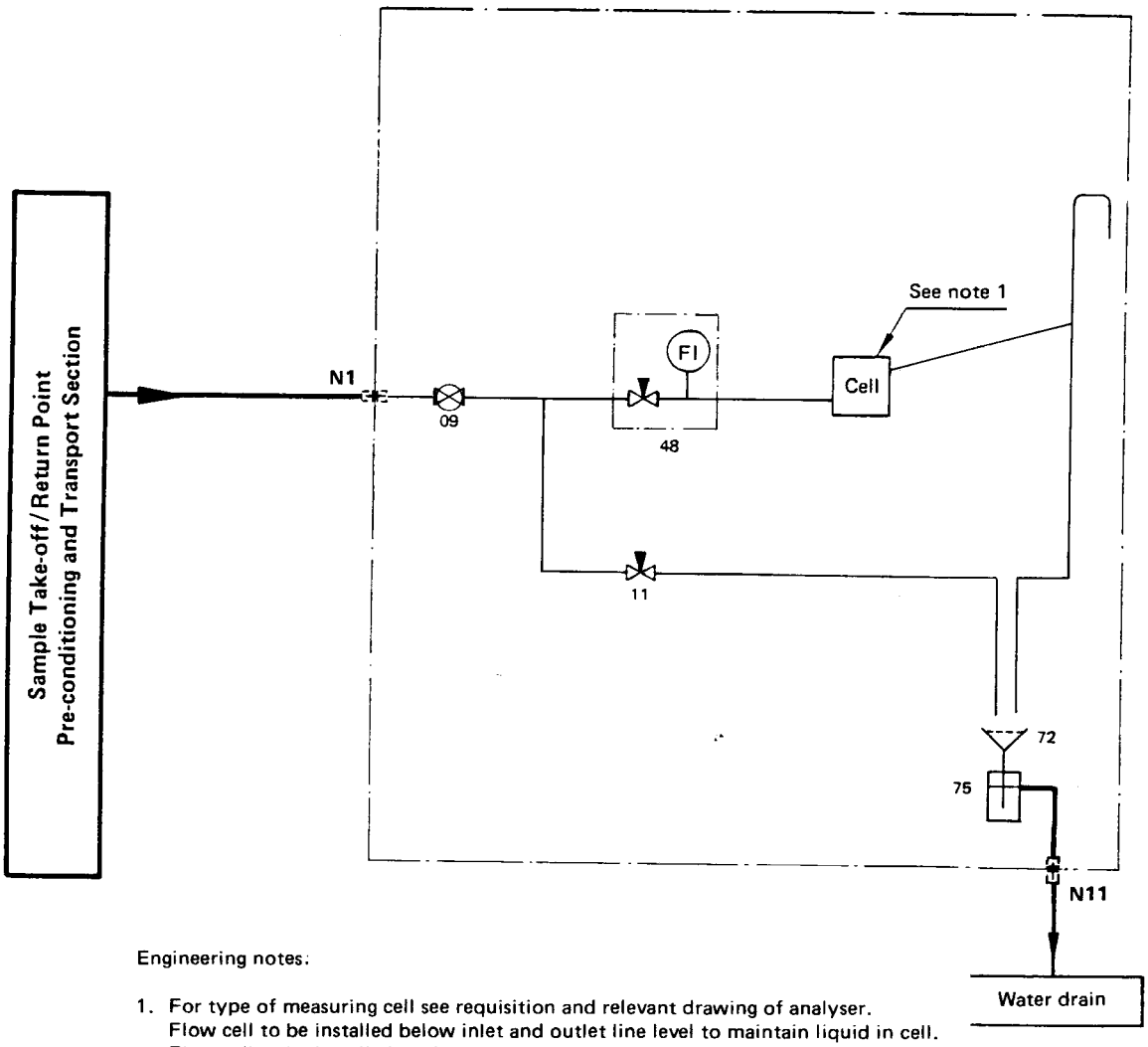
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(OIL IN WATER)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD

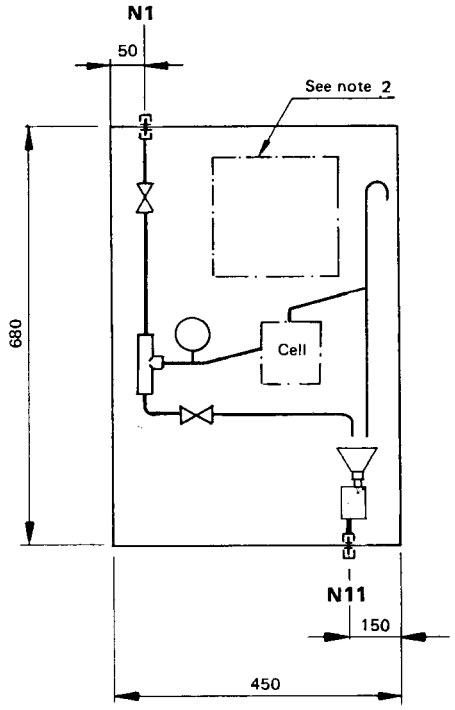
(OIL IN WATER, Cont'd)



Engineering notes:

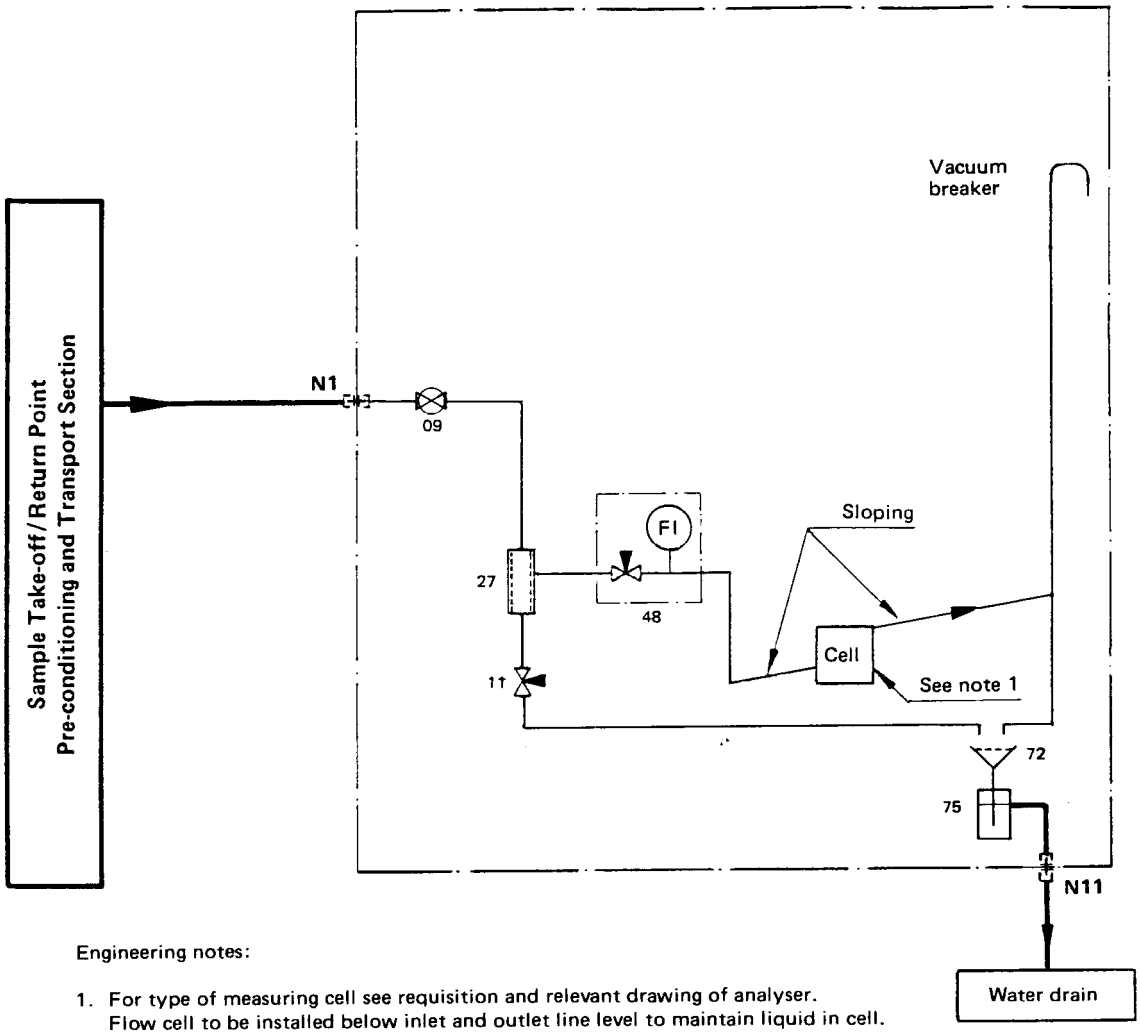
1. For type of measuring cell see requisition and relevant drawing of analyser.
   Flow cell to be installed below inlet and outlet line level to maintain liquid in cell.
   Flow cell to be installed so that gas scavenging is assured.
2. Space for transmitter and local indicator if required.
3. For description of numbered items see appendix 7.
4. Dimensions and lay-out are typical.
5. Dimensions in millimetres, unless otherwise stated.

(pH, CONDUCTIVITY)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD

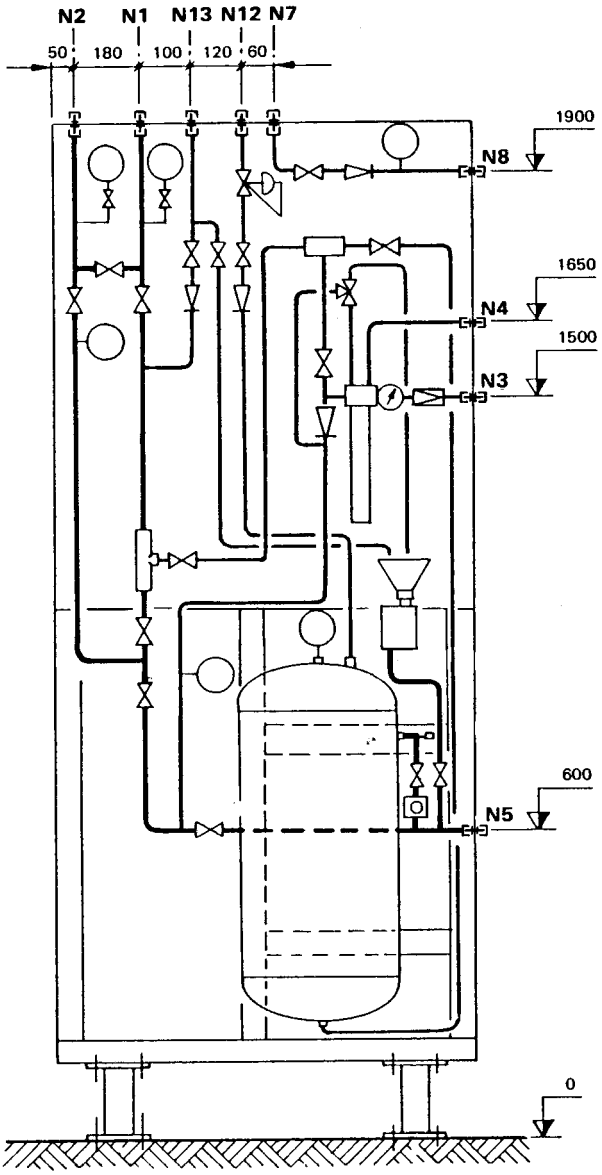
(pH, CONDUCTIVITY, Cont'd)



Engineering notes:

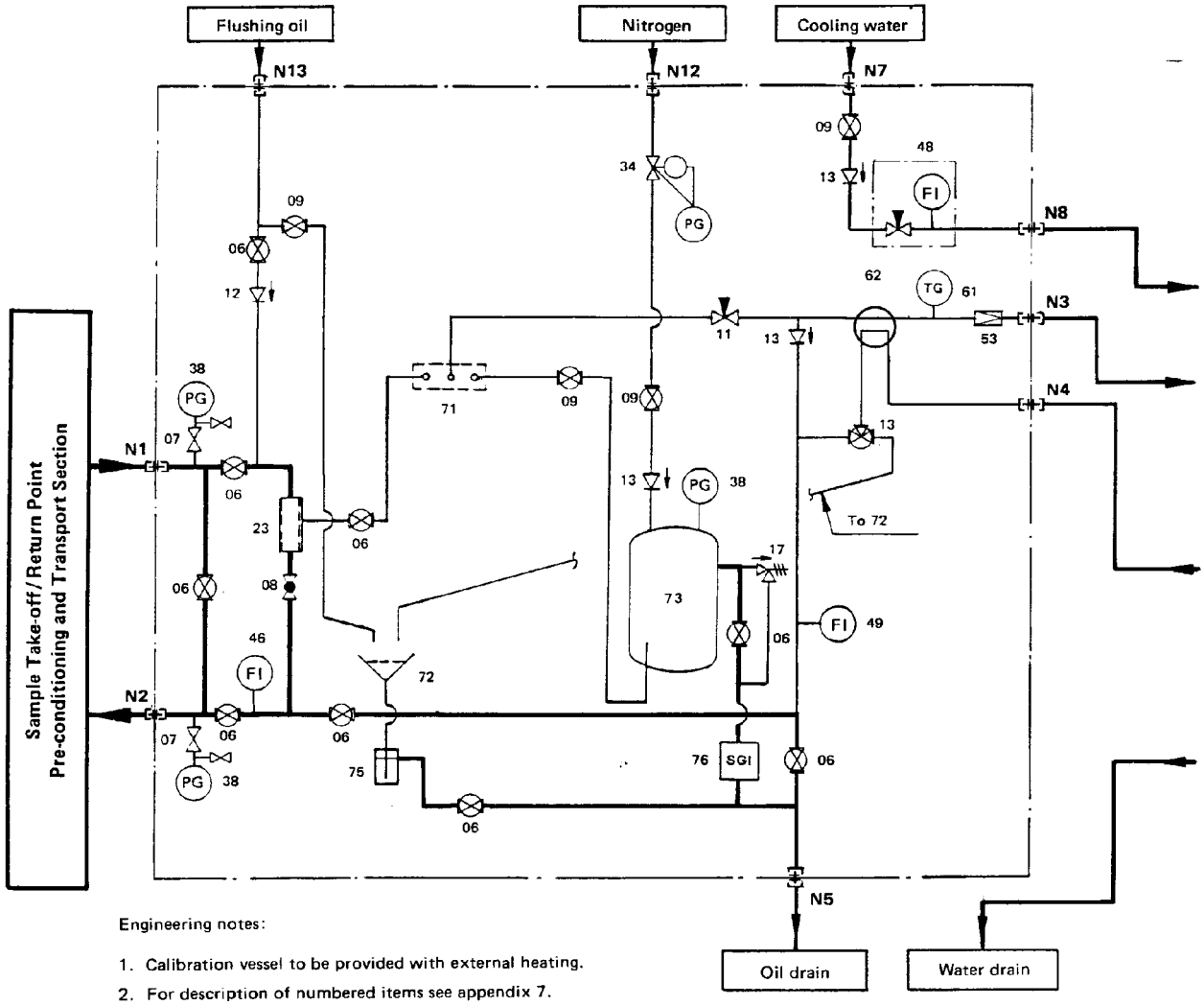
1. For type of measuring cell see requisition and relevant drawing of analyser.
   Flow cell to be installed below inlet and outlet line level to maintain liquid in cell.
   Flow cell to be installed so that gas scavenging is assured.
2. Space for transmitter and local indicator if required.
3. For description of numbered items see appendix 7.
4. Dimensions and lay-out are typical.
5. Dimensions in millimetres, unless otherwise stated.

(pH, CONDUCTIVITY WITH FILTER/COALESCER)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample fastloop inlet	Bulkhead union	12 mm OD	1/2 in. OD
N2	Sample fastloop outlet	Bulkhead union	12 mm OD	1/2 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N5	Oil drain	Bulkhead union	12 mm OD	1/2 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N8	Cooling water to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD
N13	Flushing inlet	Bulkhead union	12 mm OD	1/2 in. OD

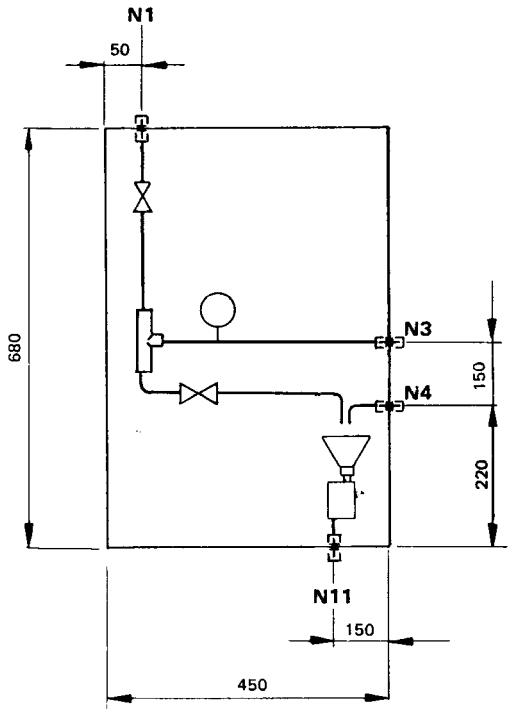
(pH, CONDUCTIVITY WITH FILTER/COALESCER, Cont'd)



Engineering notes:

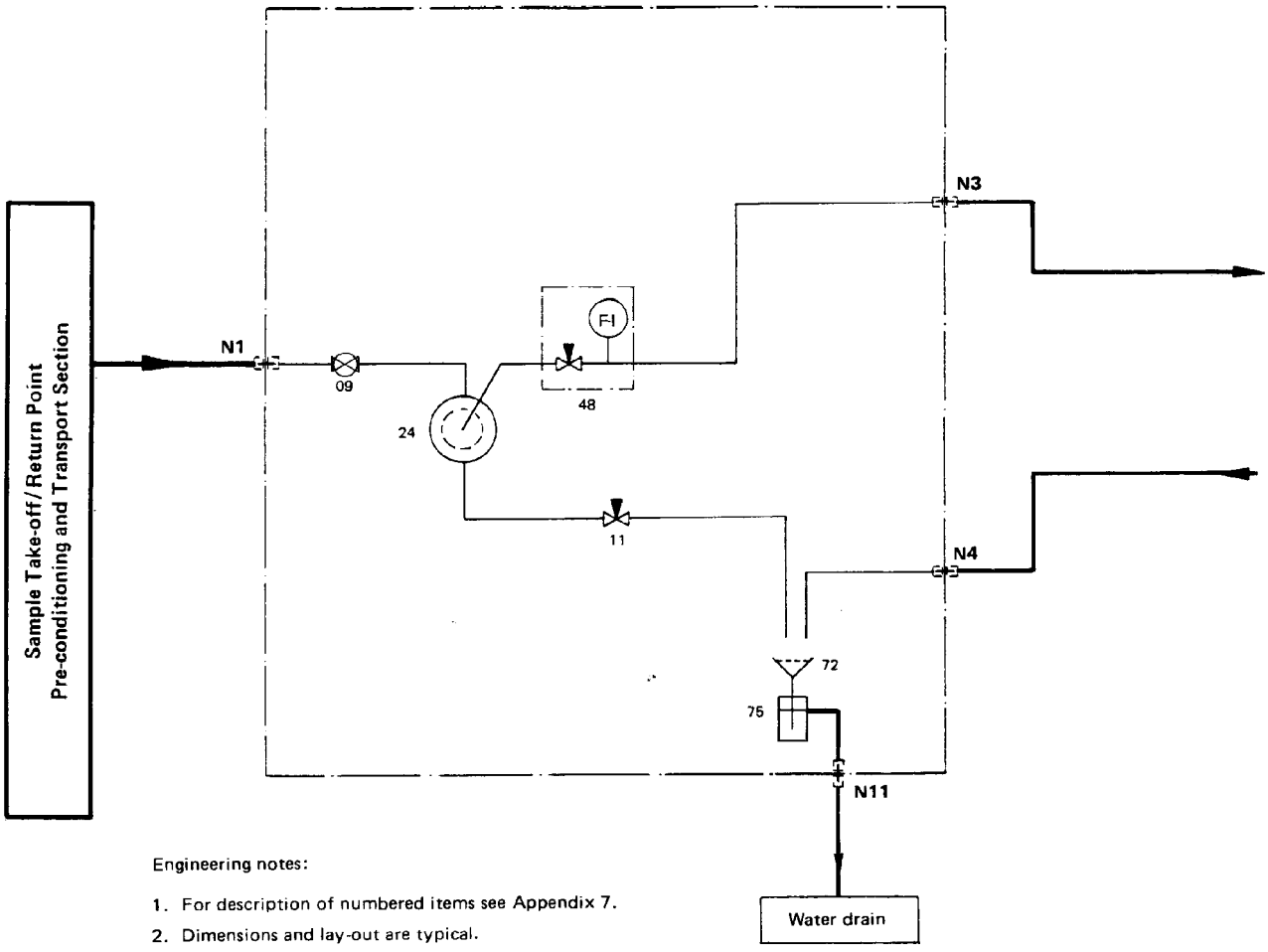
1. Calibration vessel to be provided with external heating.
2. For description of numbered items see appendix 7.
3. Dimensions and lay-out are typical.
4. Dimensions in millimetres, unless otherwise stated.

(VISCOSITY)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N4	Sample return from analyser	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	6 mm OD	1/4 in. OD

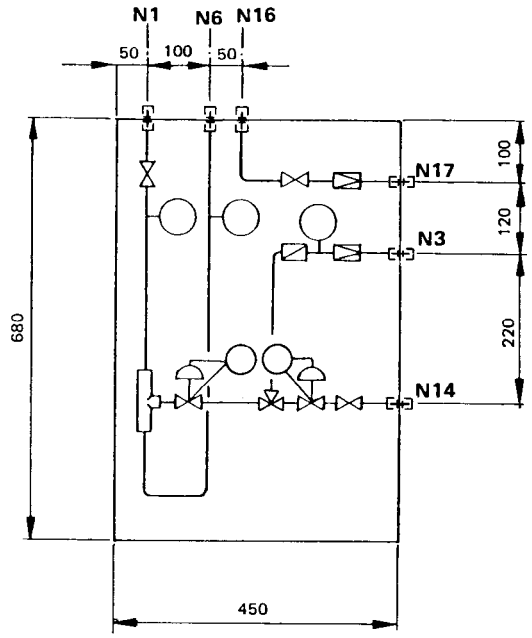
(VISCOSITY, Cont'd)



Engineering notes:

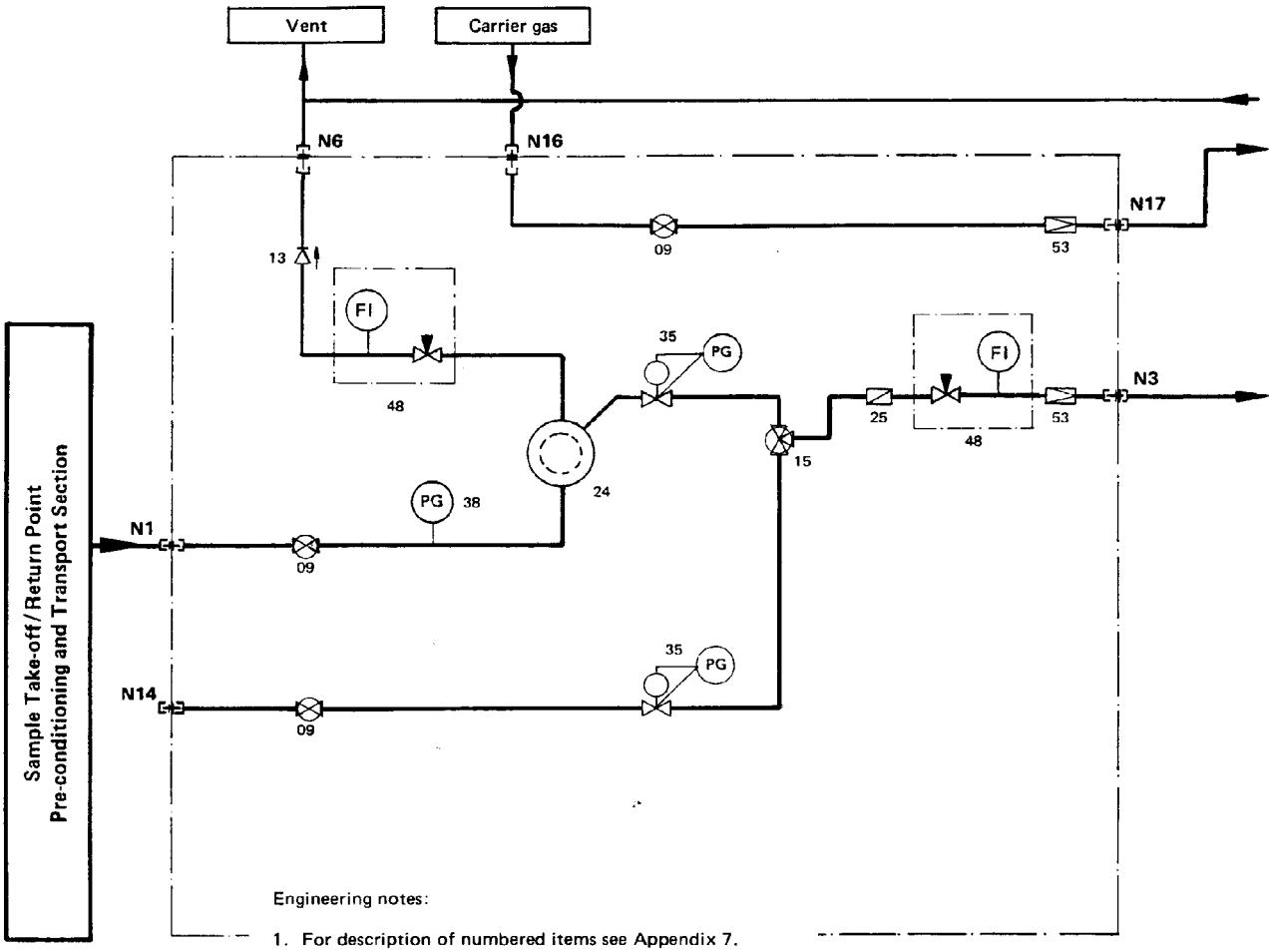
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(WATER HARDNESS)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	3 mm OD	1/8 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N16	Carrier gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Carrier gas analyser	Bulkhead union	6 mm OD	1/4 in. OD

(WATER HARDNESS, Cont'd)

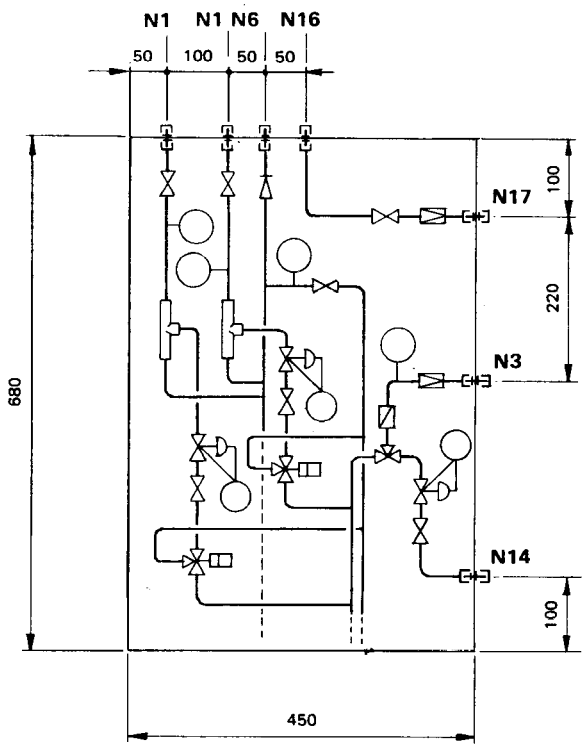


Engineering notes:

1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

SINGLE STREAM

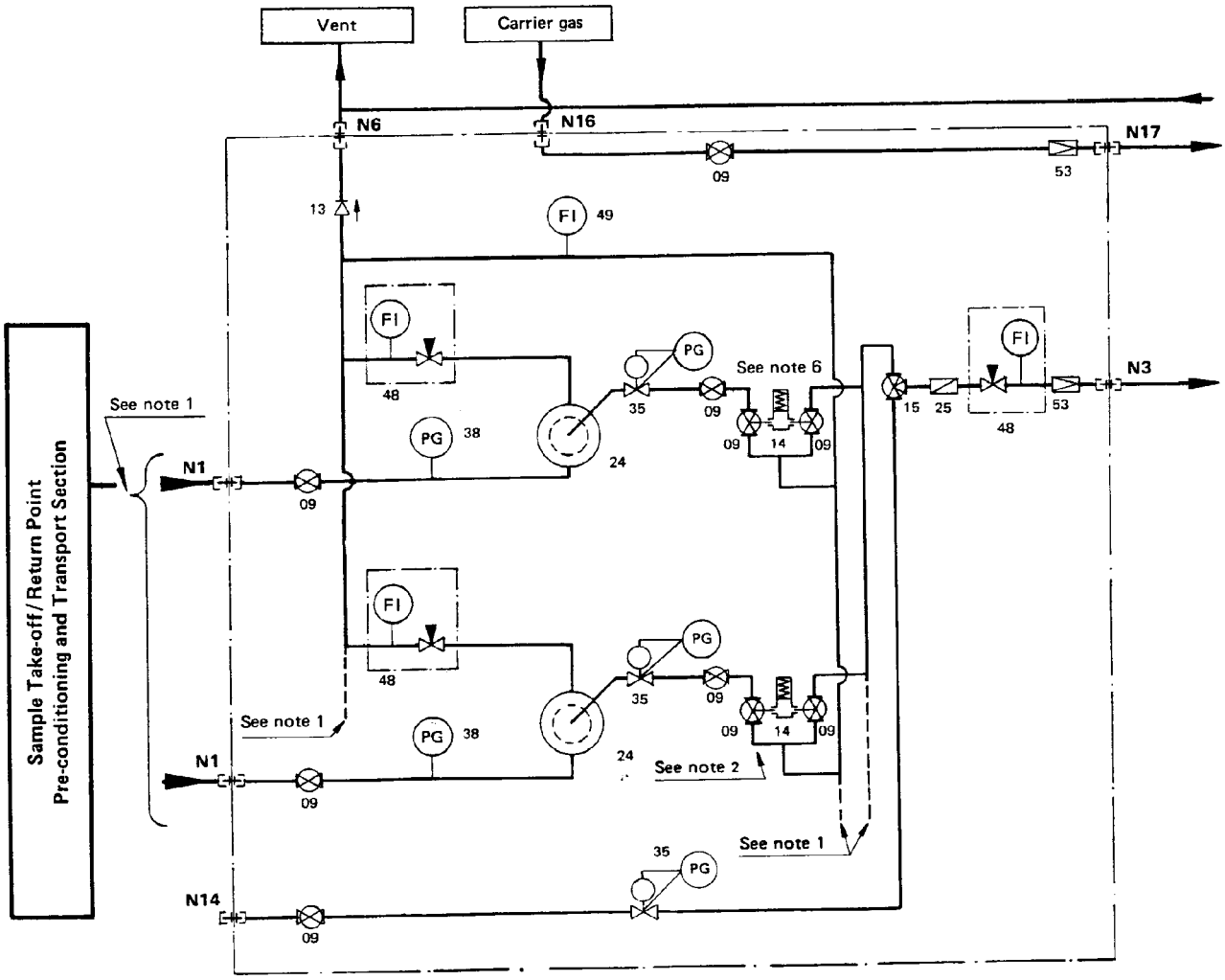
(CHROMATOGRAPH, GAS SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	3 mm OD	1/8 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N16	Carrier gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Carrier gas to analyser	Bulkhead union	6 mm OD	1/4 in. OD

SINGLE STREAM

(CHROMATOGRAPH, GAS SAMPLE, Cont'd)

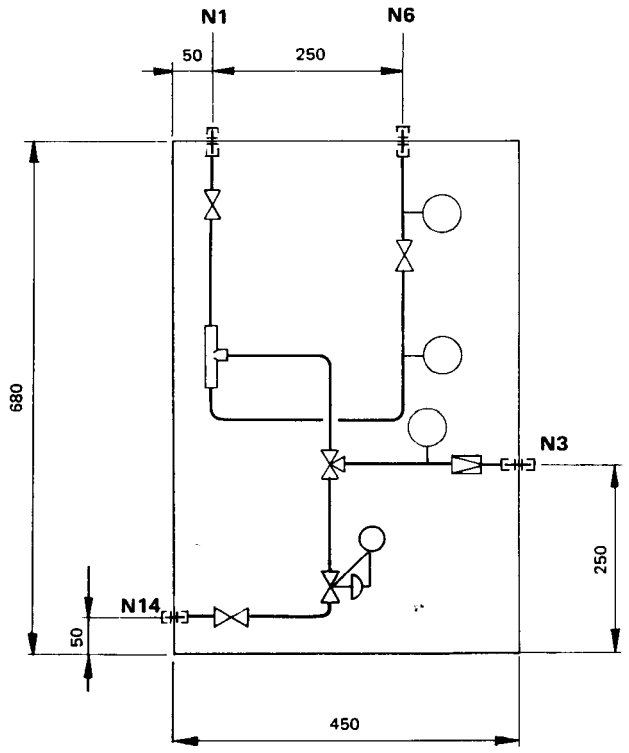


Engineering notes:

1. For number of sample streams, see requisition.
2. Pneumatic operated ball valves to be controlled by process chromatograph stream sector via solenoid valves.
3. For description of numbered items see appendix 7.
4. Dimensions and lay-out are typical.
5. Dimensions in millimetres, unless otherwise stated.
6. Two ball valves operated by one pneumatic actuator.

MULTI STREAM

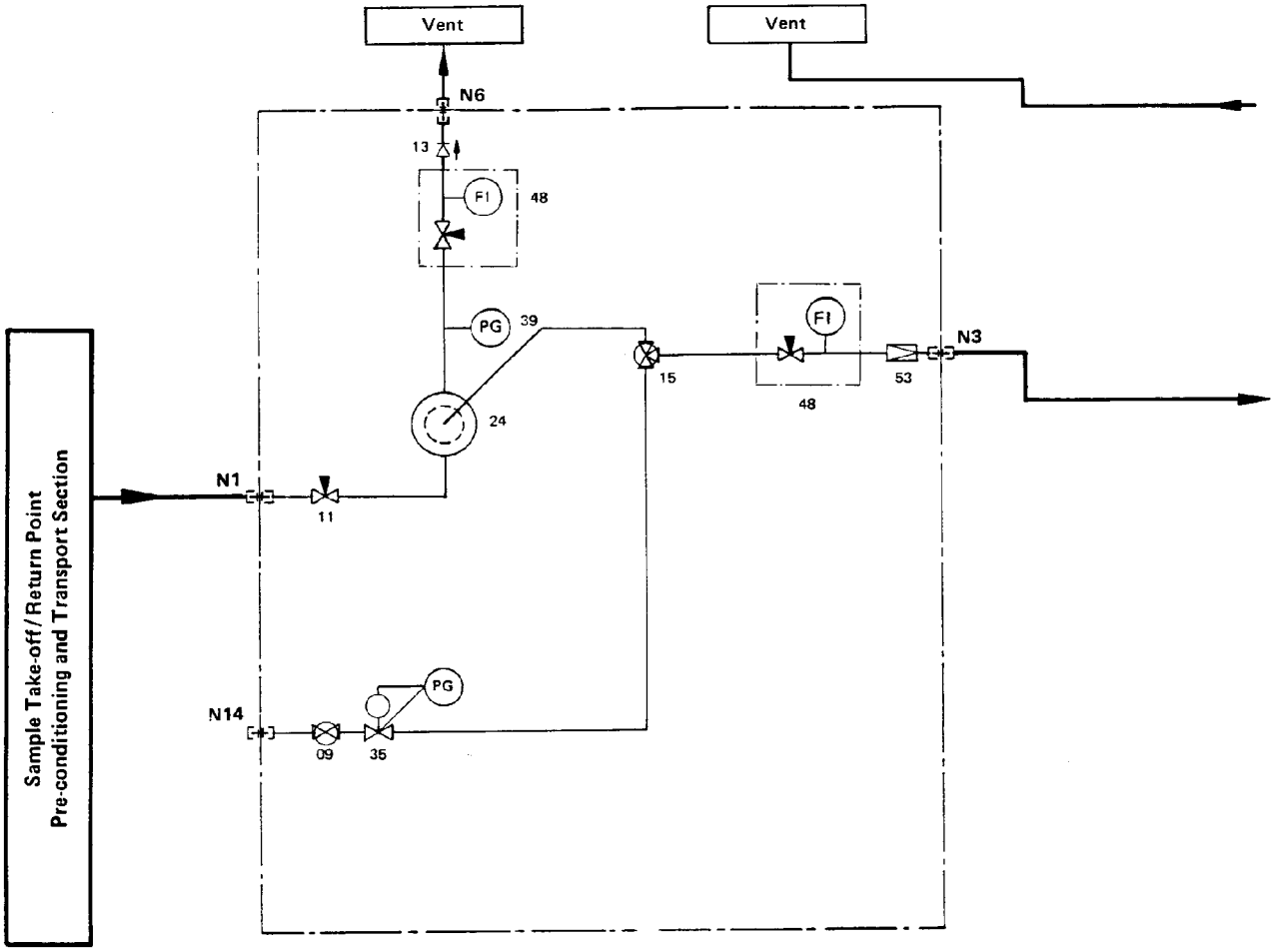
(CHROMATOGRAPH , GAS SAMPLE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration gas inlet	Bulkhead union	6 mm OD	1/4 in. OD

MULTI STREAM

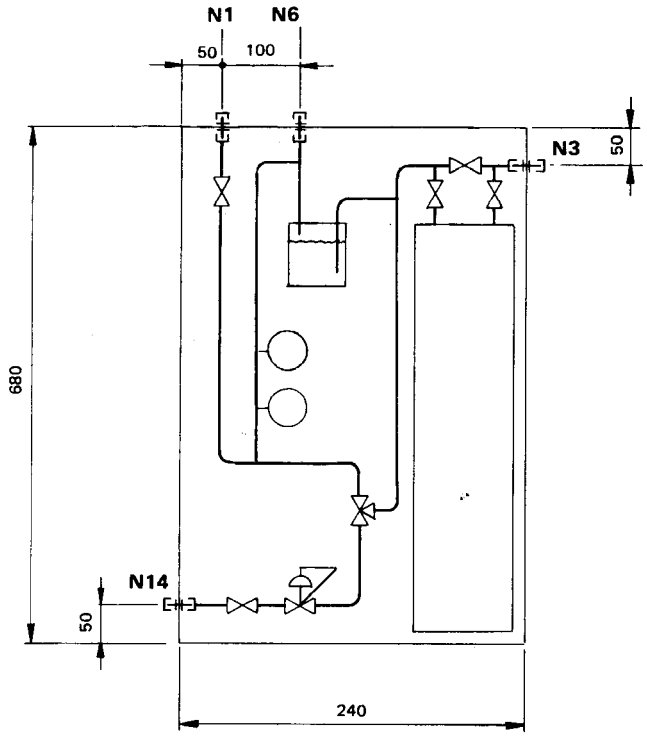
(CHROMATOGRAPH , GAS SAMPLE, Cont'd)



Engineering notes:

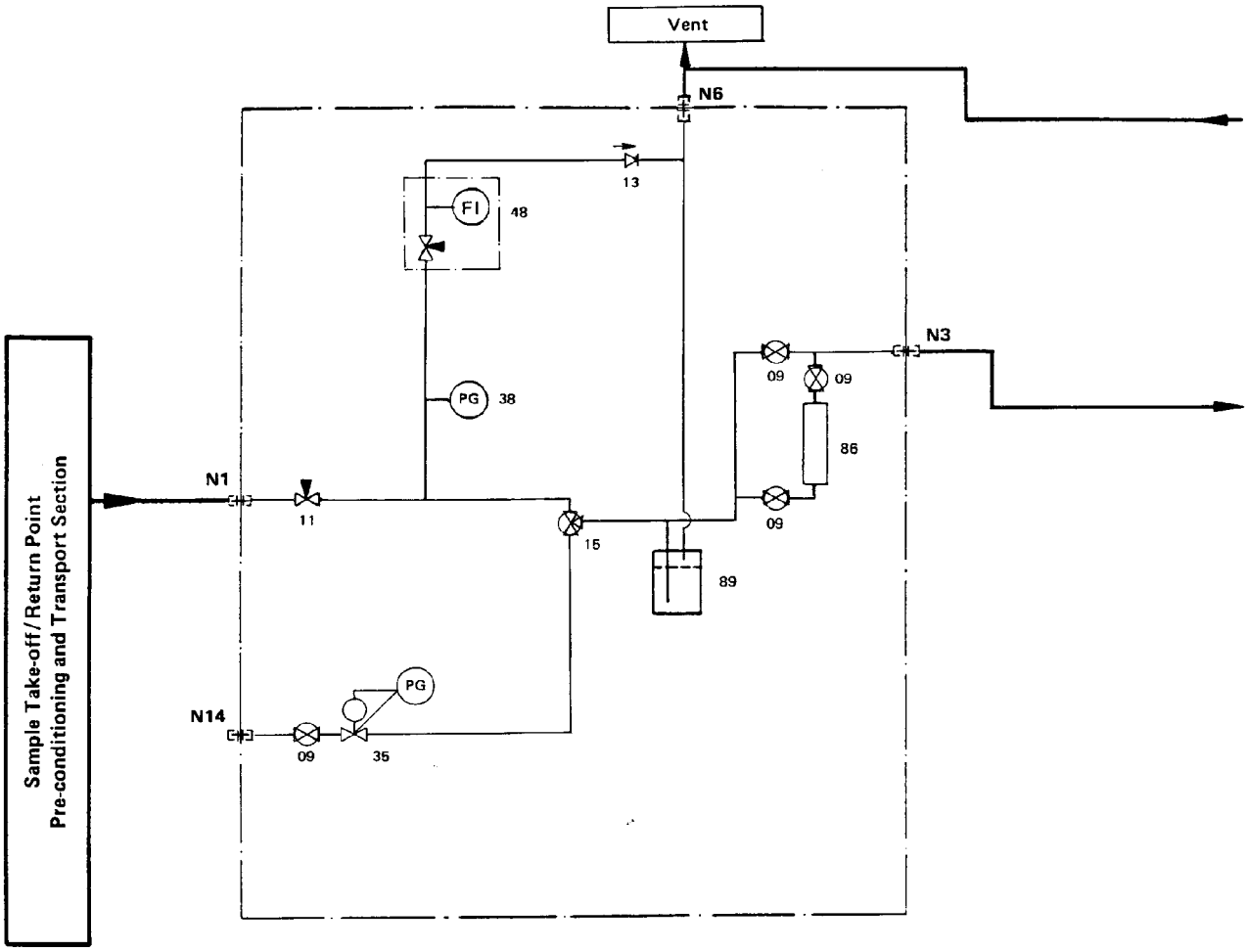
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DENSITY - GAS)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N2	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration gas inlet	Bulkhead union	6 mm OD	1/4 in. OD

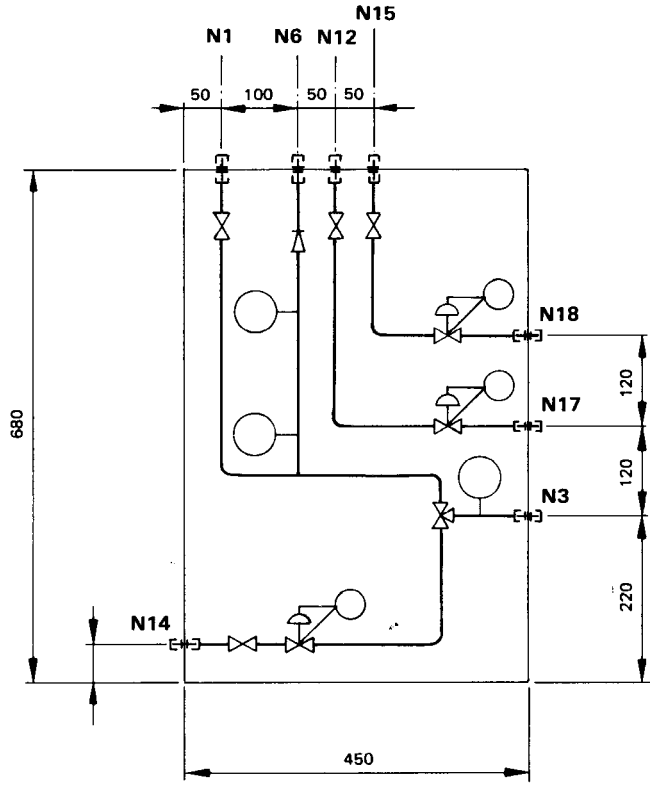
(DENSITY - GAS, Cont'd)



Engineering notes:

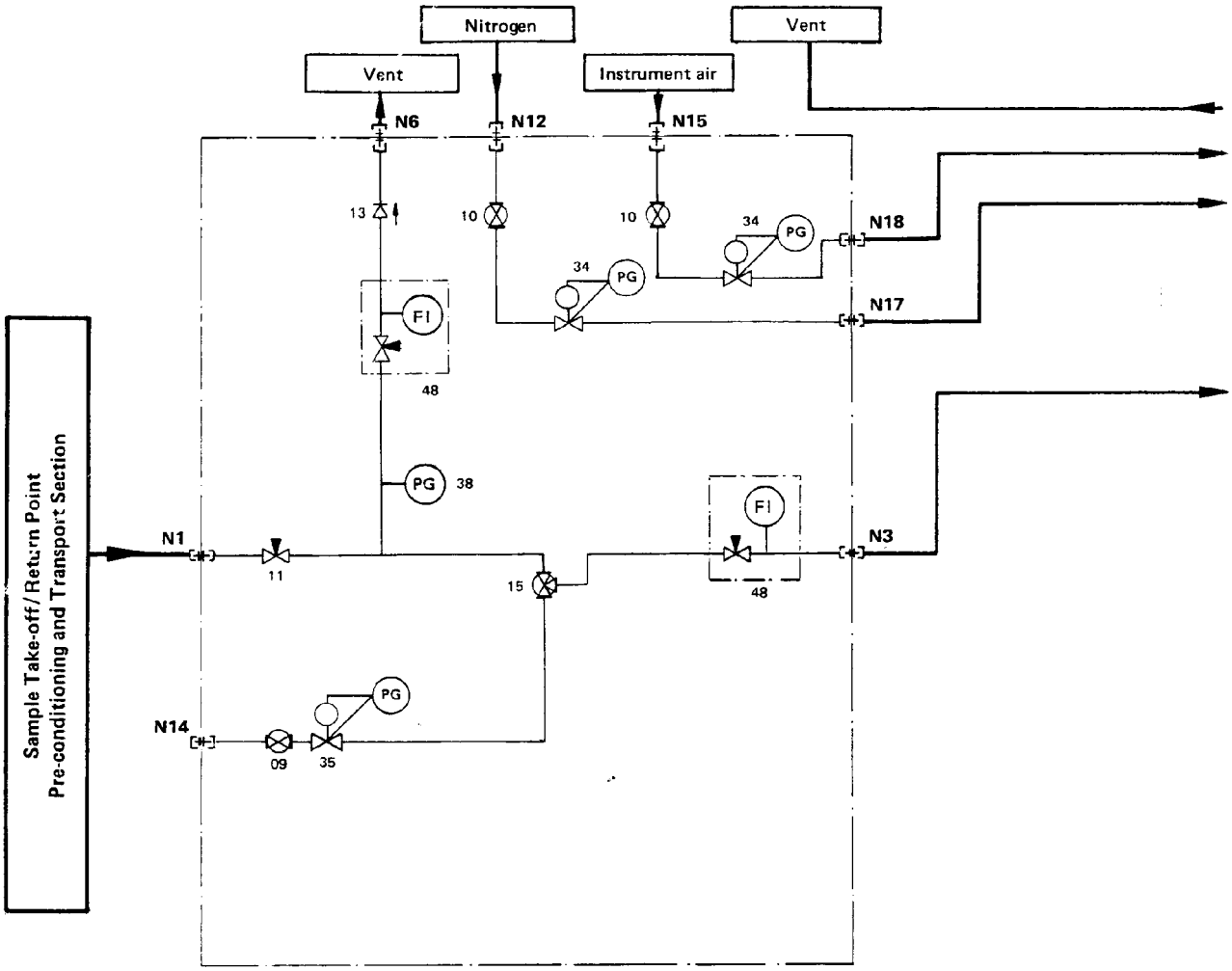
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(DENSITY - GAS, MAKE DEBRO)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N15	Instrument air inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Calibration gas to analyser	Bulkhead union	6 mm OD	1/4 in. OD

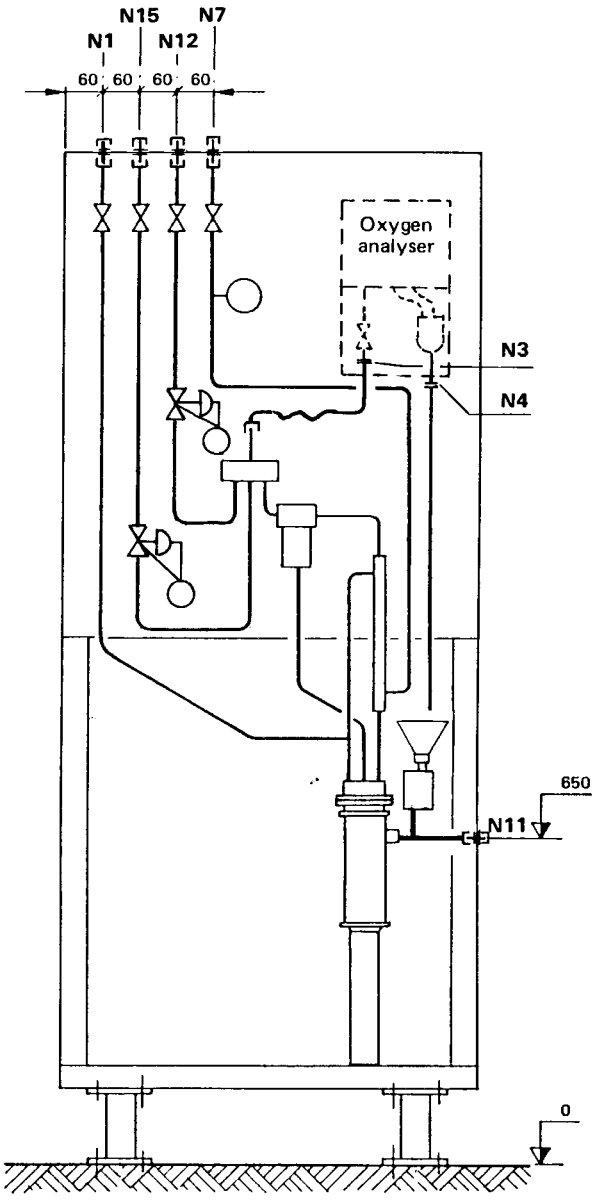
(DENSITY - GAS, MAKE DEBRO, Cont'd)



Engineering notes:

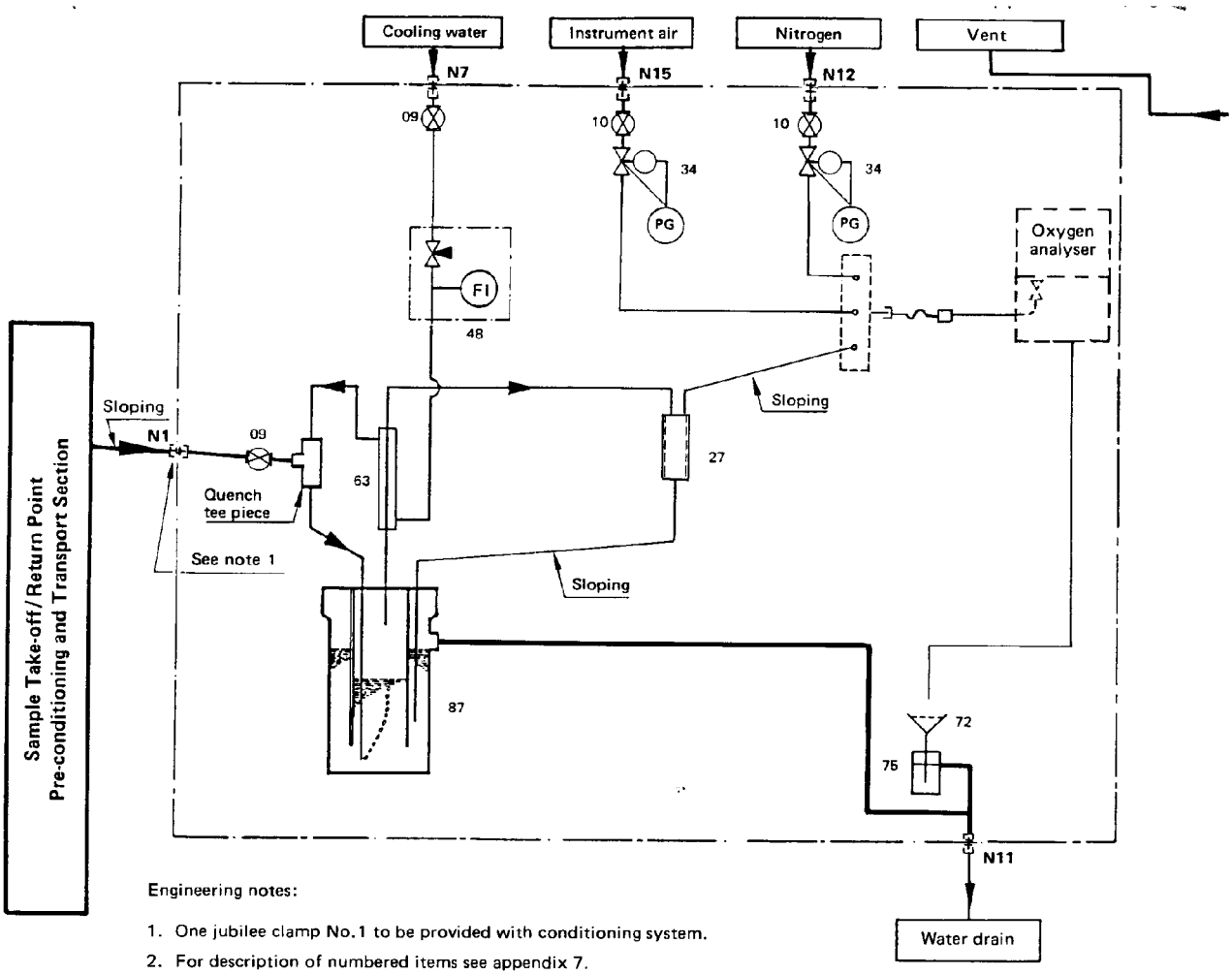
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(OXYGEN)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N7	Cooling water inlet	Bulkhead union	6 mm OD	1/4 in. OD
N11	Water drain	Bulkhead union	12 mm OD	1/2 in. OD
N12	Nitrogen inlet	Bulkhead union	6 mm OD	1/4 in. OD
N15	Instrument air inlet	Bulkhead union	6 mm OD	1/4 in. OD

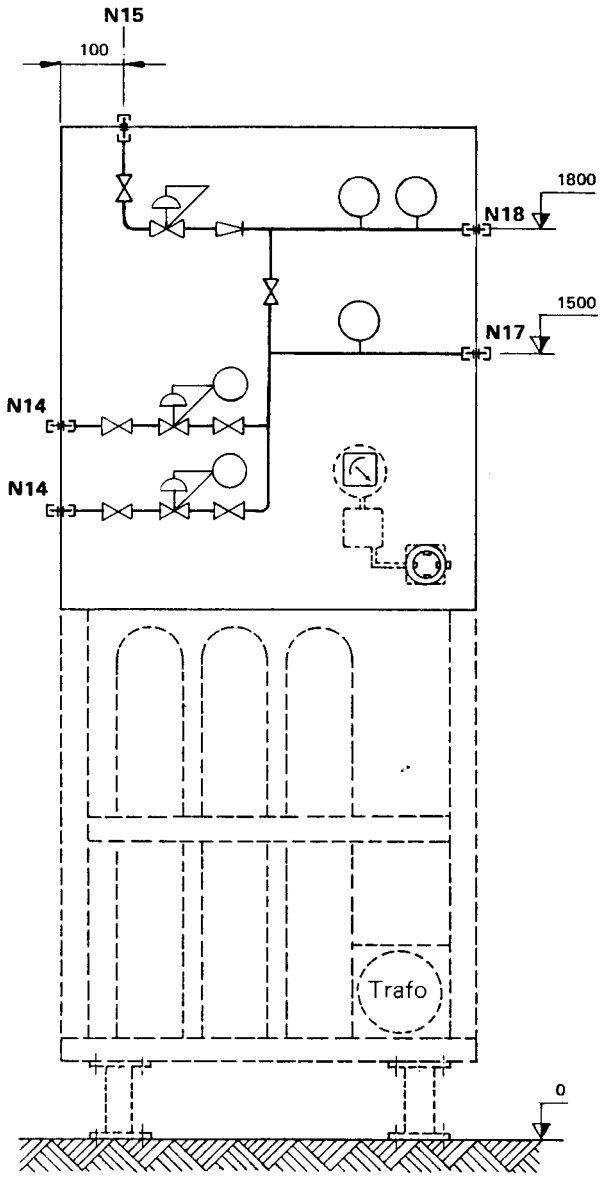
(OXYGEN, Cont'd)



Engineering notes:

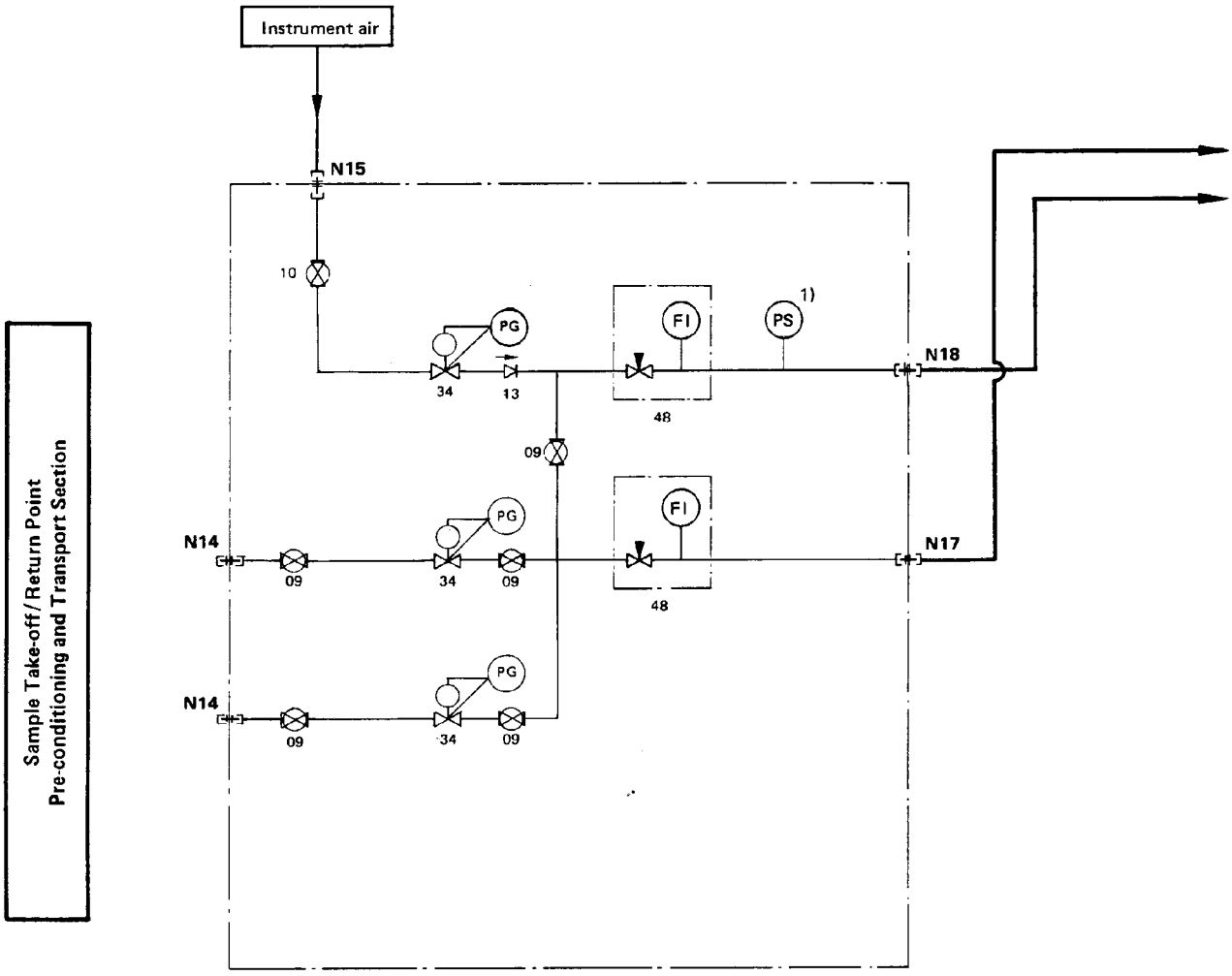
1. One jubilee clamp No.1 to be provided with conditioning system.
2. For description of numbered items see appendix 7.
3. Dimensions and lay-out are typical.
4. Dimensions in millimetres, unless otherwise stated.

(OXYGEN, MAKE SERVOMEX)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N14	Calibration gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N15	Instrument air inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Calibration gas to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N18	Instrument air to analyser	Bulkhead union	6 mm OD	1/4 in. OD

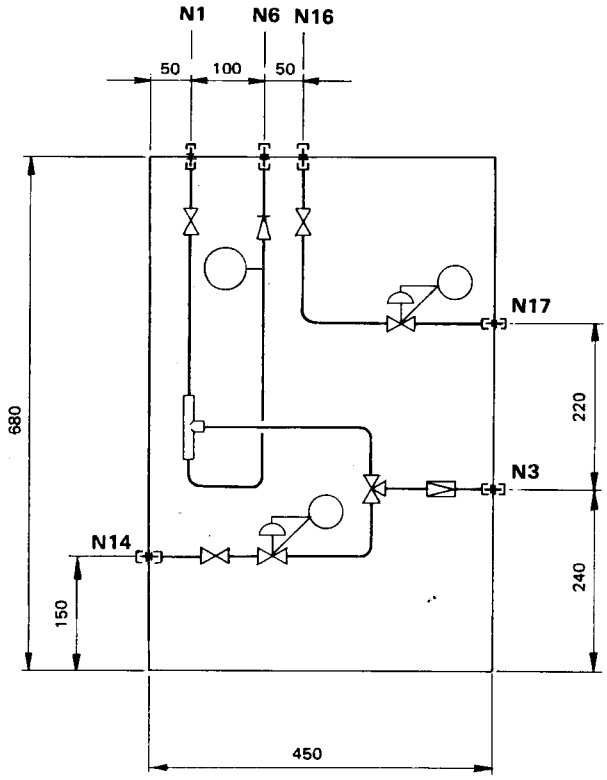
(OXYGEN, MAKE SERVOMEX, Cont'd)



Engineering notes:

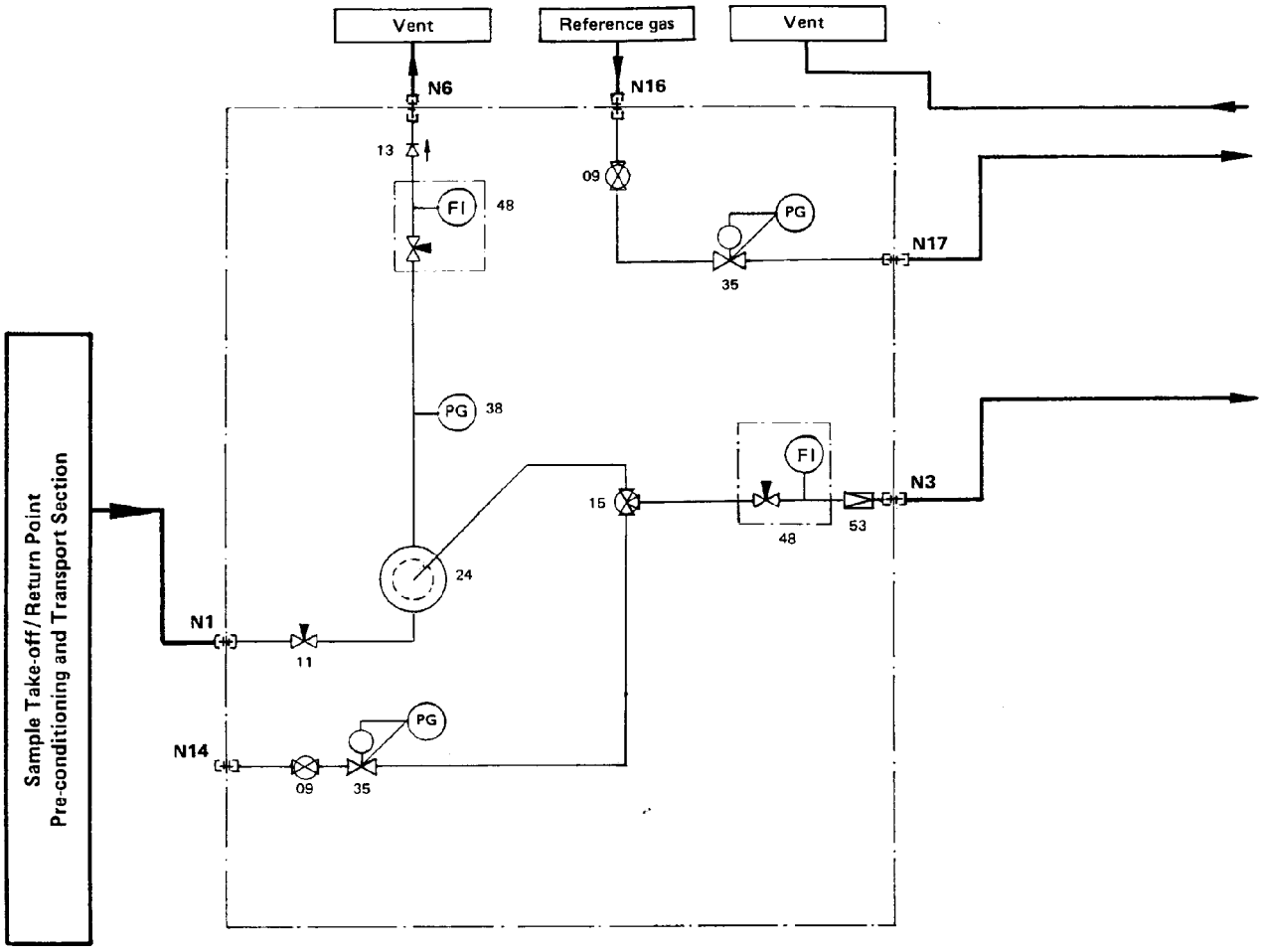
1. Pressure switch explosion proof make: United Electric, type J - 110.
2. For description of numbered items see appendix 7.
3. Dimensions and lay-out are typical.
4. Dimensions in millimetres, unless otherwise stated.

(OXYGEN, FLUE GAS, MAKE WESTINGHOUSE)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD
N14	Calibration sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N16	Reference gas inlet	Bulkhead union	6 mm OD	1/4 in. OD
N17	Reference gas to analyser	Bulkhead union	6 mm OD	1/4 in. OD

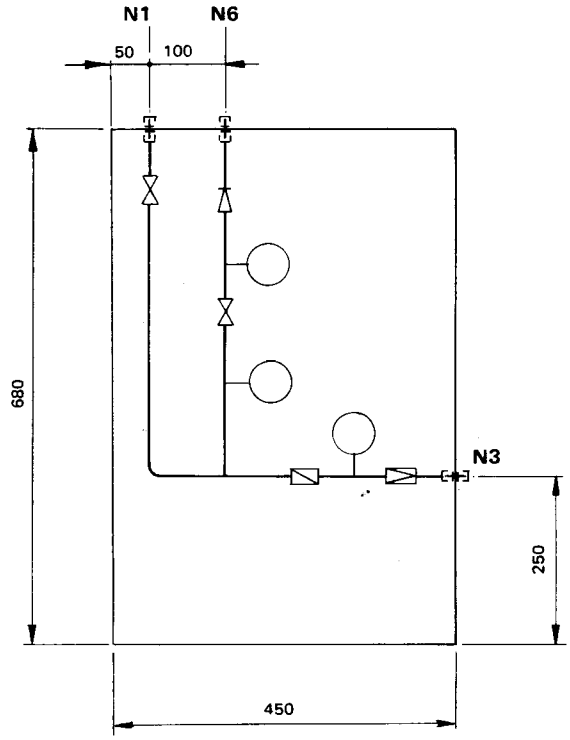
(OXYGEN, FLUE GAS, MAKE WESTINGHOUSE, Cont'd)



Engineering notes:

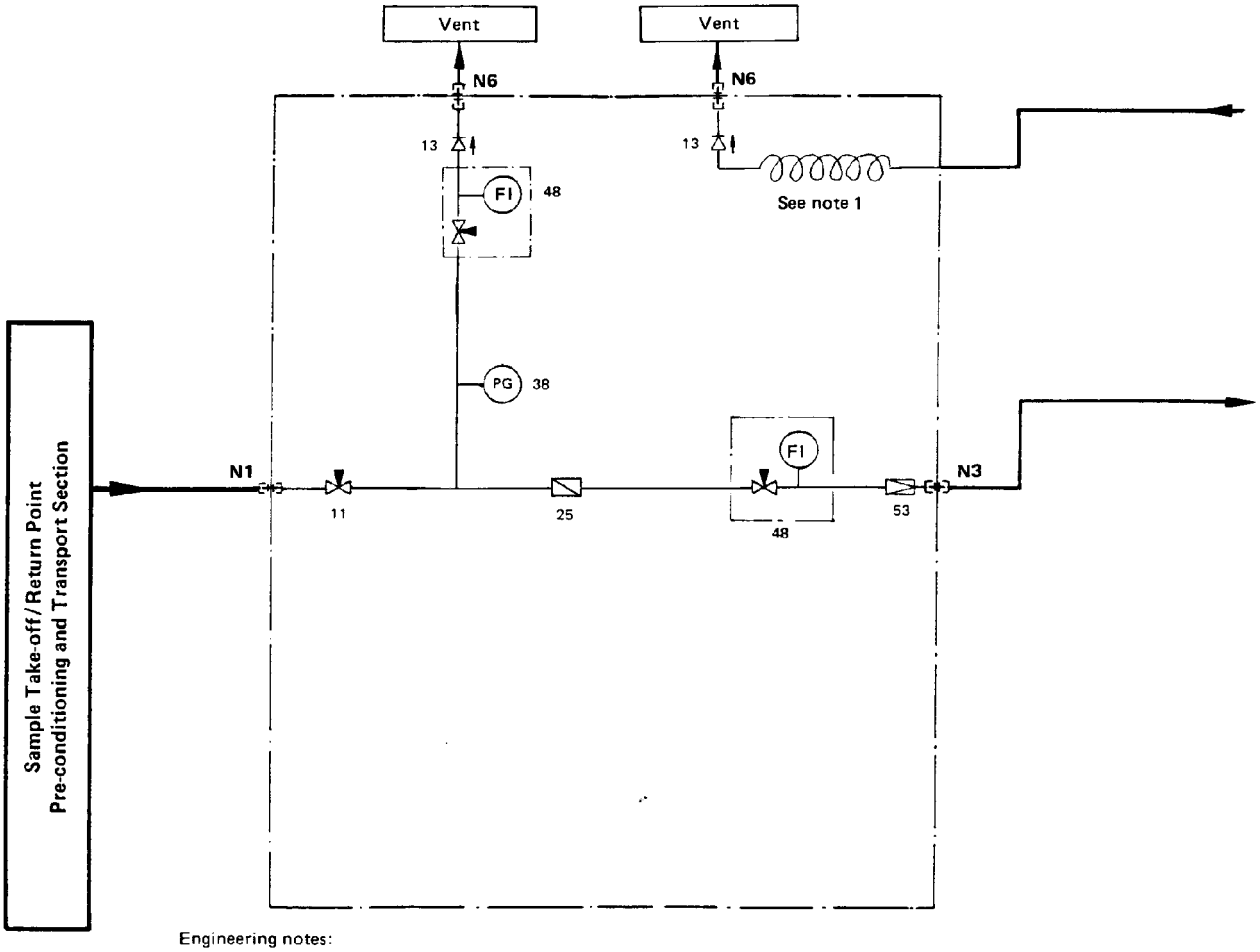
1. For description of numbered items see Appendix 7.
2. Dimensions and lay-out are typical.
3. Dimensions in millimetres, unless otherwise stated.

(THERMAL CONDUCTIVITY)



Conn.	Description	Connections		
		Compression type	Metric	Imperial
N1	Sample inlet	Bulkhead union	6 mm OD	1/4 in. OD
N3	Sample to analyser	Bulkhead union	6 mm OD	1/4 in. OD
N6	Sample to vent	Bulkhead union	6 mm OD	1/4 in. OD

(THERMAL CONDUCTIVITY, Cont'd)



Engineering notes:

1. Coil length to be minimum 5 metres.
2. For description of numbered items see appendix 7.
3. Dimensions and lay-outs are typical.
4. Dimensions in millimetres, unless otherwise stated.

(WATER CONTENT)

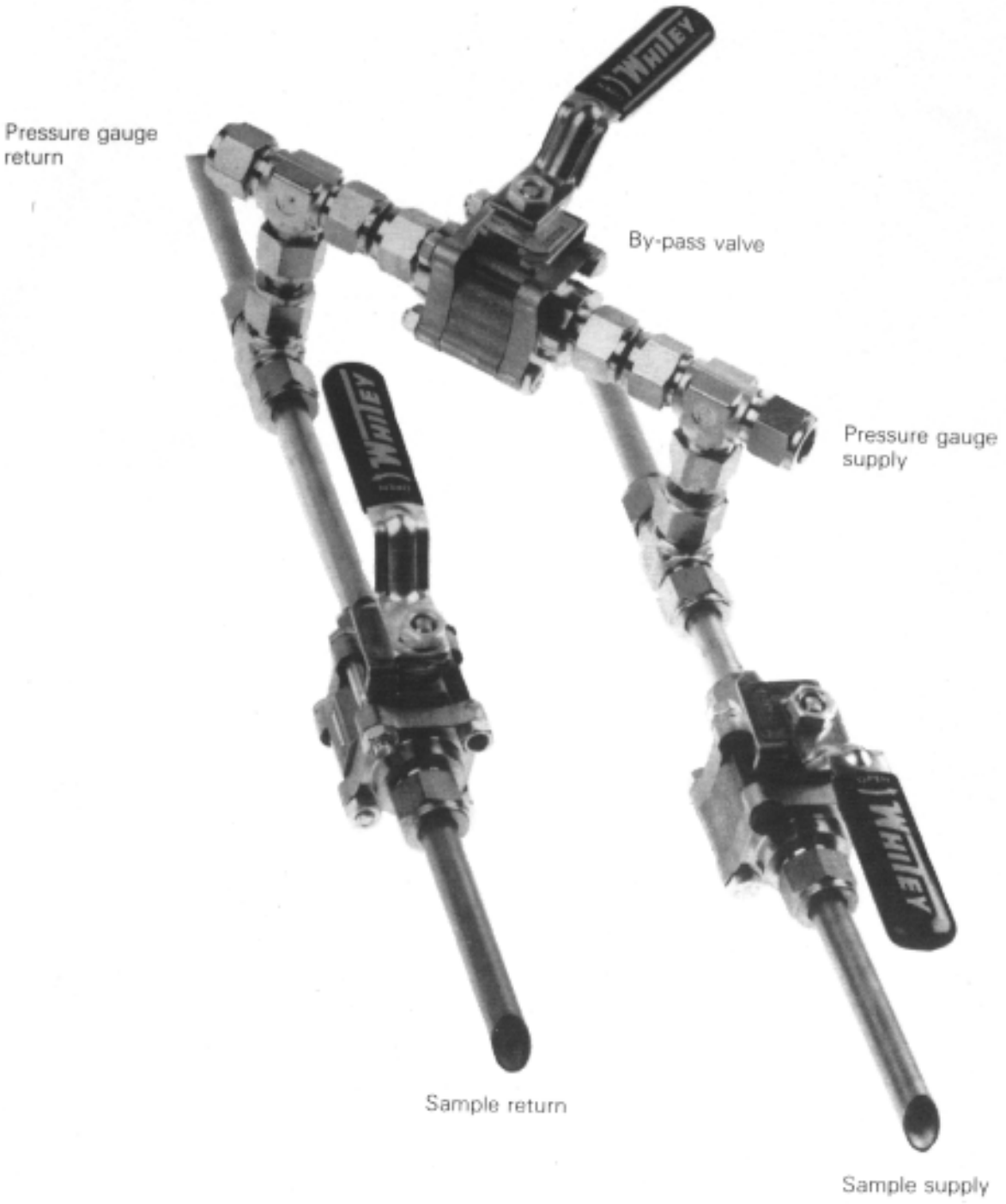
APPENDIX 3 TYPICAL MOUNTING ARRANGEMENTS

Sample inlet and return with by-pass valve

Pressure gauge connected to a compression fitting

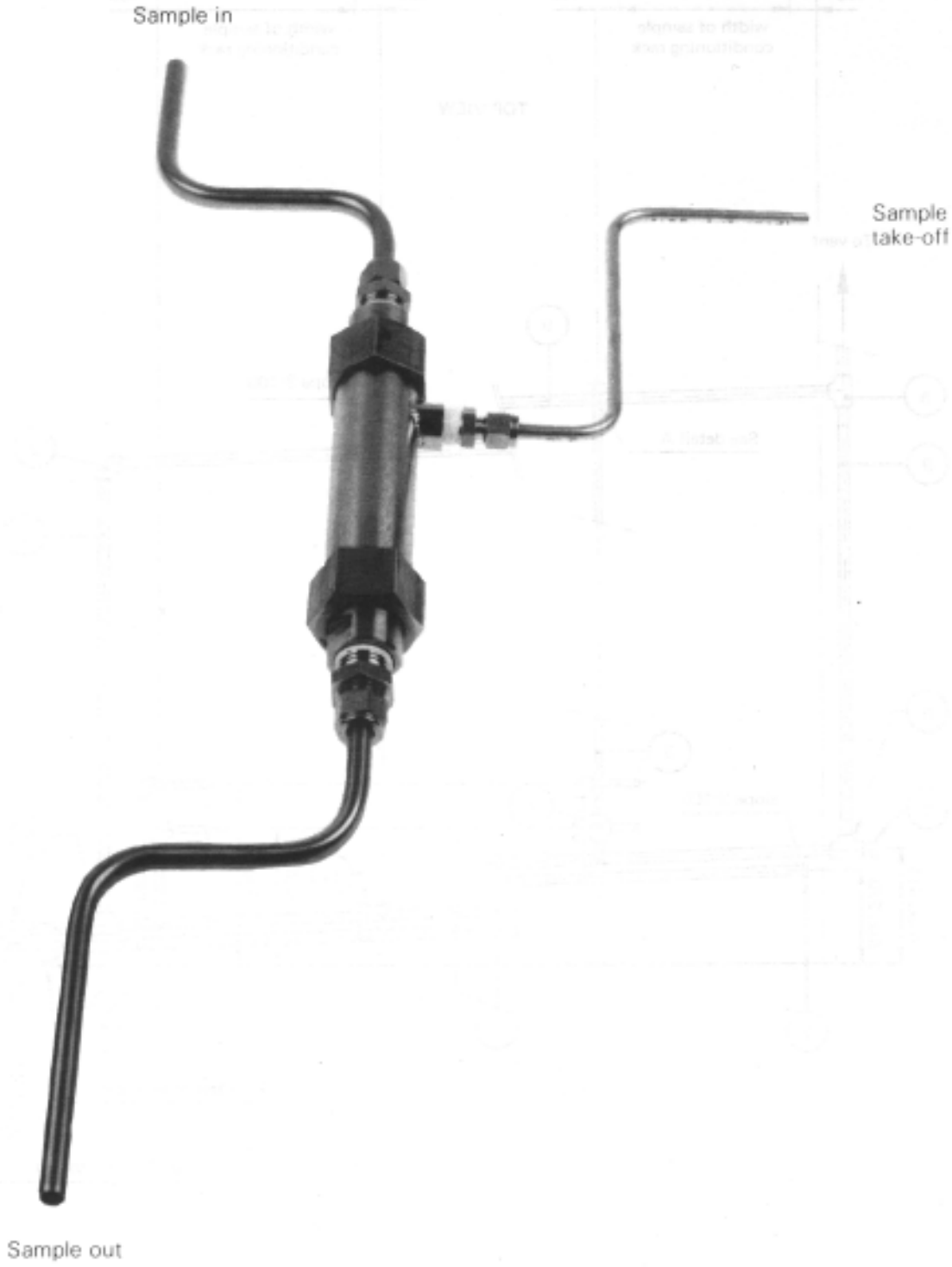
Hook-up of a filter

SAMPLE INLET AND RETURN WITH BY-PASS VALVE

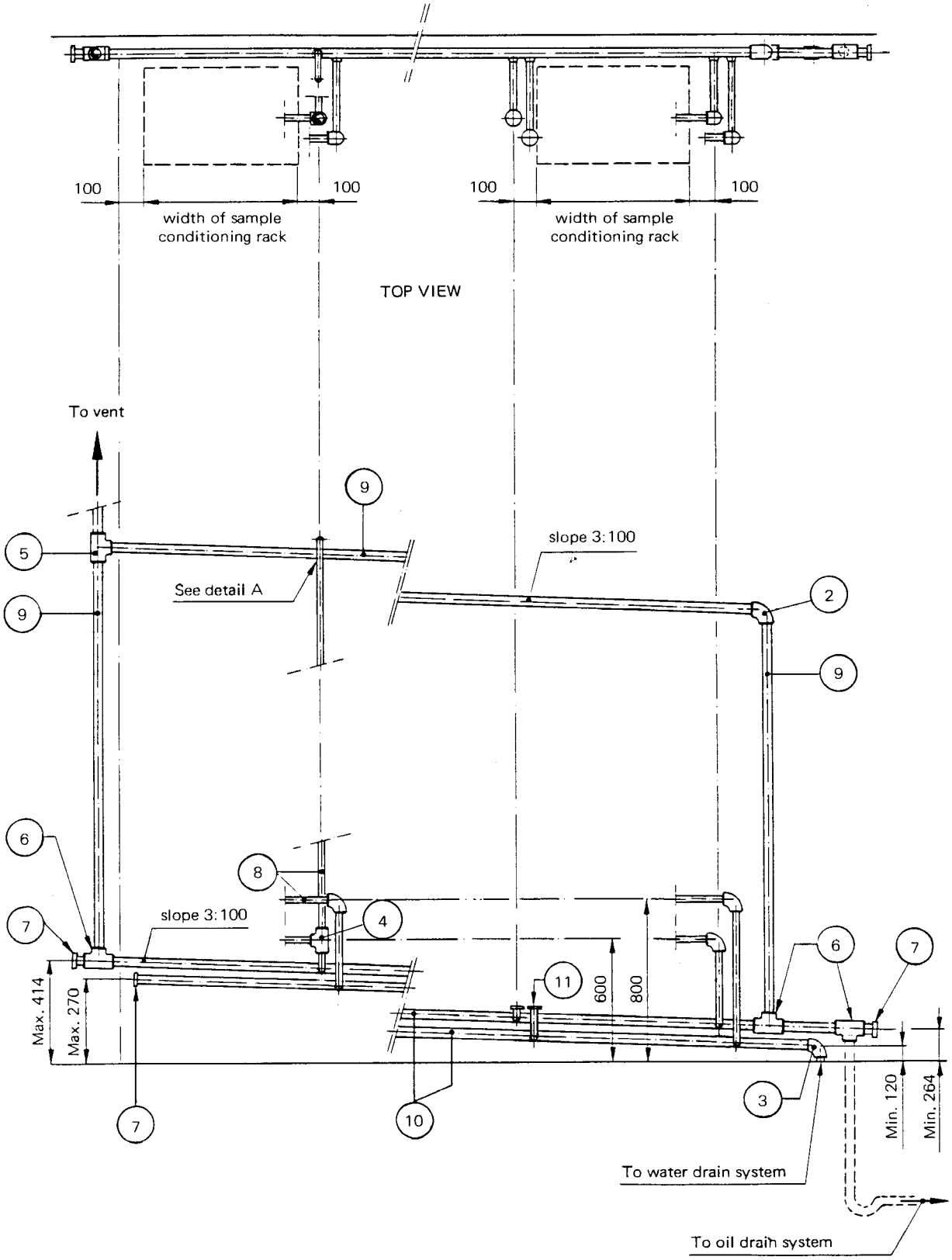


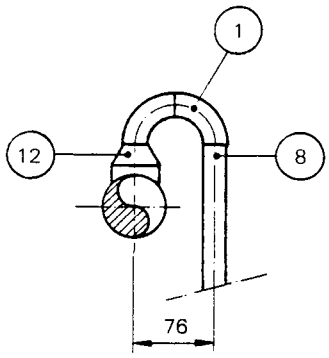
PRESSURE GAUGE CONNECTED TO A COMPRESSION FITTING

HOOK-UP OF A FILTER



APPENDIX 4 TYPICAL VENT AND DRAIN SYSTEM FOR ANALYSER HOUSES





DETAIL A

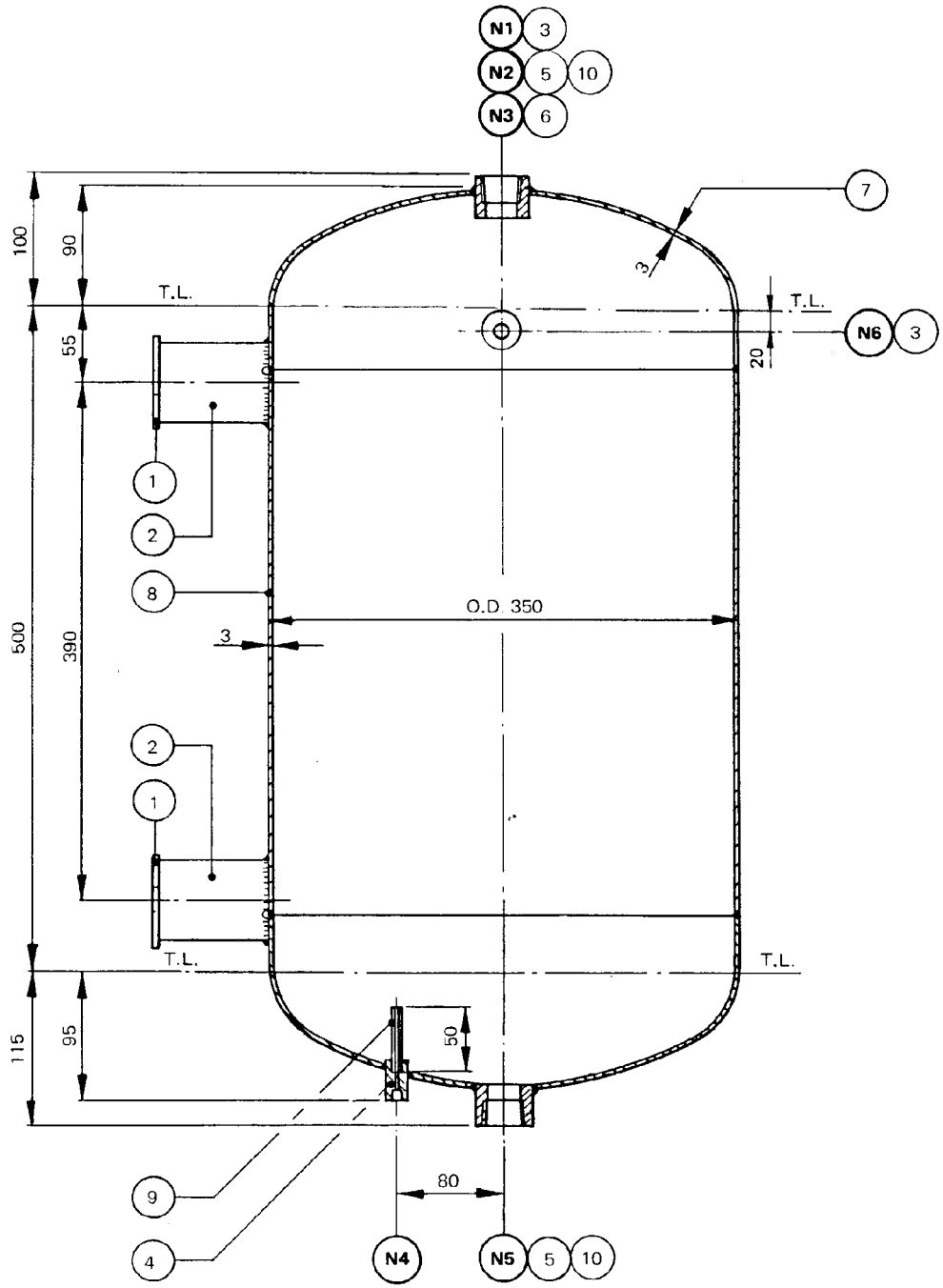
Item	Qty.	Description		Material	Remarks
1	–	Elbow	DN 15 (1/2 in.)	See note 1	
2	1	Elbow	DN 50 (2 in.)	See note 1	
3	1	Elbow	DN 80 (3 in.)	See note 1	
4	–	Tee	DN 15 (1/2 in.)	See note 1	
5	1	Tee	DN 50 (2 in.)	See note 1	
6	3	Tee	DN 80 (3 in.)	See note 1	
7	3	Plug	DN 80 (3 in.)	See note 1	Removable
8	–	Line pipe	DN 15 (1/2 in.)	See note 1	
9	–	Line pipe	DN 50 (2 in.)	See note 1	
10	–	Line pipe	DN 80 (3 in.)	See note 1	
11	–	Cap 1/2" NPT threaded		See note 1	
12	–	Branch nipple	DN 15 (1/2 in.)	See note 1	

Engineering notes:

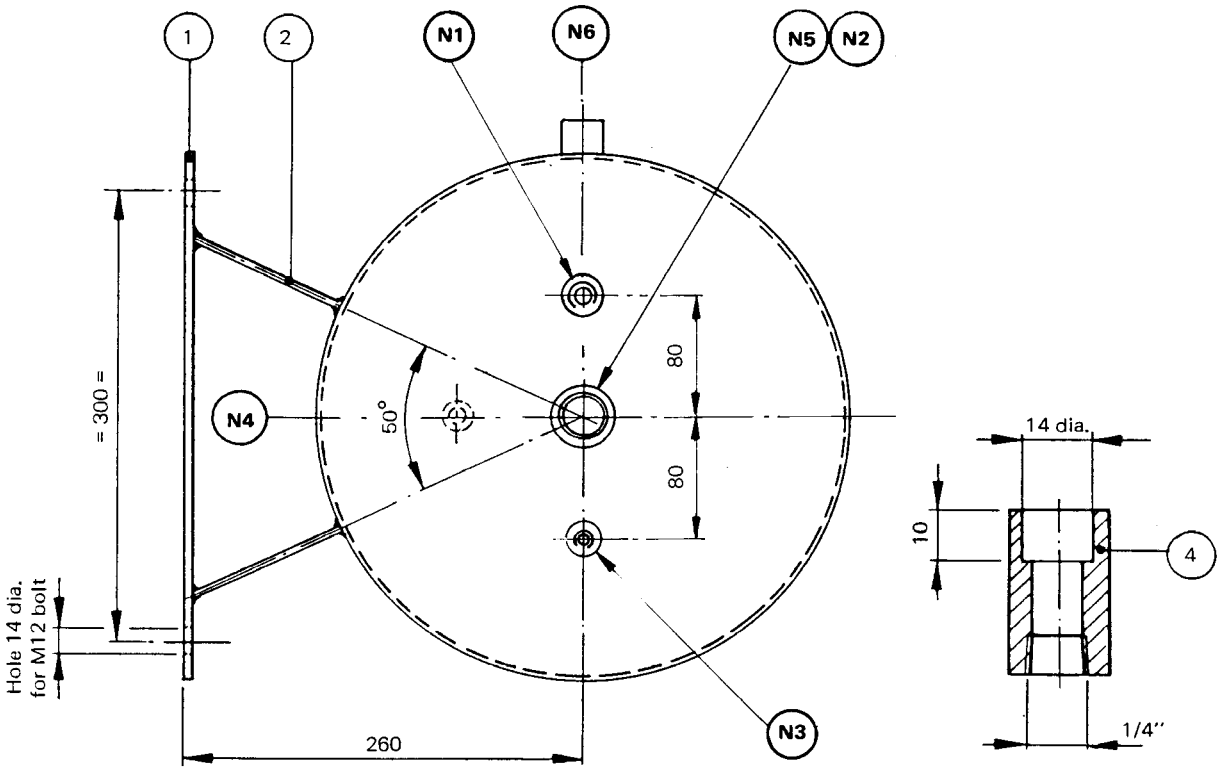
1. Vent and drain system shall be constructed from materials as specified by the Principal.
2. For typical arrangements of sample conditioning racks, see Appendix 1.
3. Dimensions in millimetres, unless otherwise stated.

TYPICAL VENT AND DRAIN SYSTEM FOR ANALYSER HOUSE(Cont'd)

APPENDIX 5 VESSEL FOR TEST AND CALIBRATION SERVICES



Nozzle (See note 1)	Description
N1	Pressure gauge connection
N2	Connection for cleaning purposes or eventually temperature measurement.
N3	Pressurizing connection
N4	Product inlet/outlet connection
N5	Drain connection for cleaning purposes
N6	Overflow



TOP VIEW
NOZZLE ORIENTATION

DETAIL A

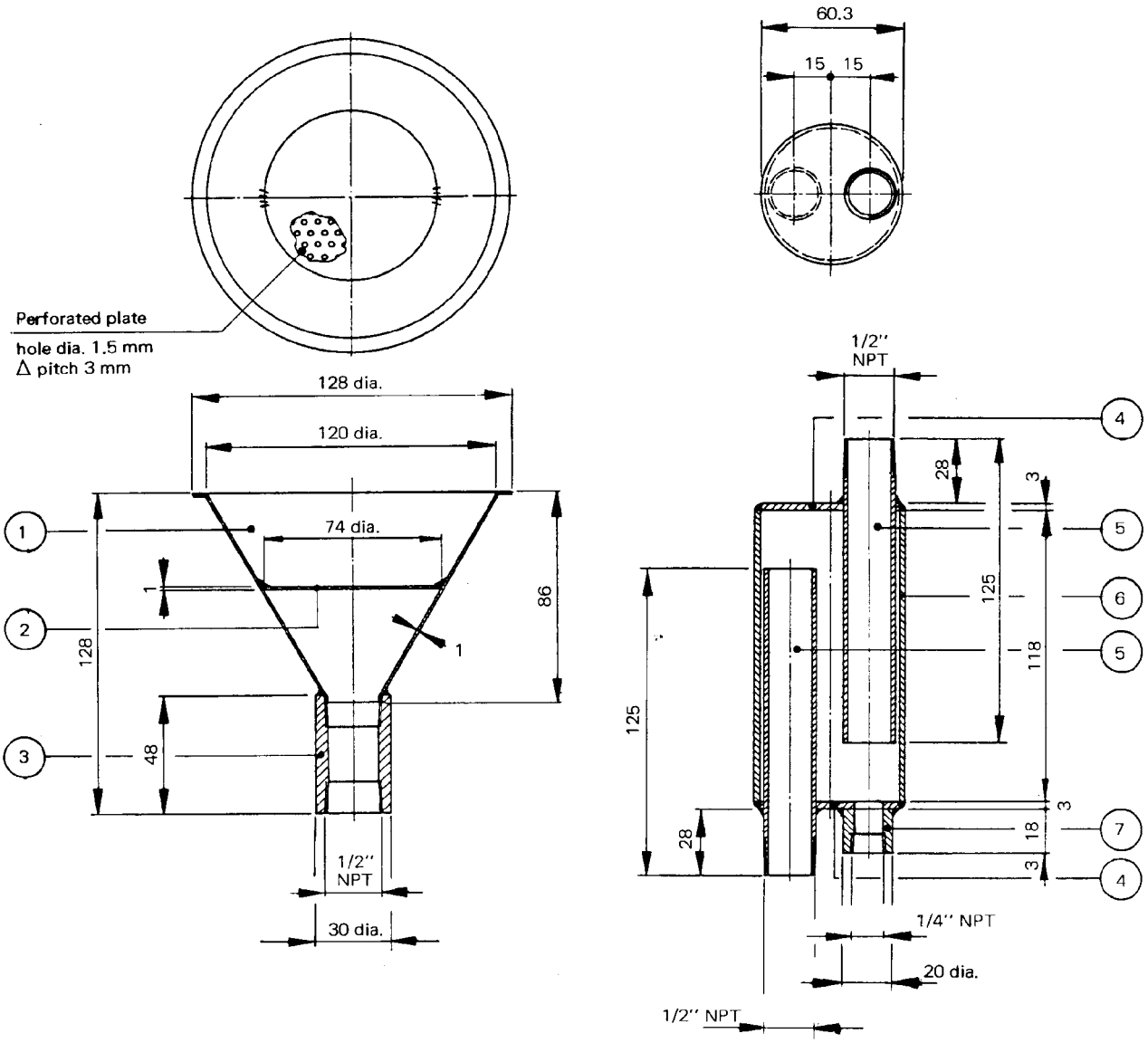
Item	Qty.	Description	Material	Remarks
1	2	Flat 350 x 70 x 6	ASTM A-283-C	Max. 0.23% C.
2	4	Flat 150 x 60 x 3	ASTM A-240-type 316	
3	2	1/2" half coupling 3000 lb	ASTM A-403-WP 316	
4	1	Modified 1/4" coupling 3000 lb	ASTM A-403-WP 316	See detail A
5	2	1" half coupling 3000 lb	ASTM A-403-WP 316	
6	1	1/4" half coupling 3000 lb	ASTM A-403-WP 316	
7	2	Head 'Korbbogen'-type	ASTM A-240-type 316	Or deepdished
8	1	Shell	ASTM A-240-type 316	
9	1	1/4" line pipe, schedule 10 S	ASTM A-312-TP 316	
10	2	1" plug, hex. head	ASTM A-276-type 316 L	

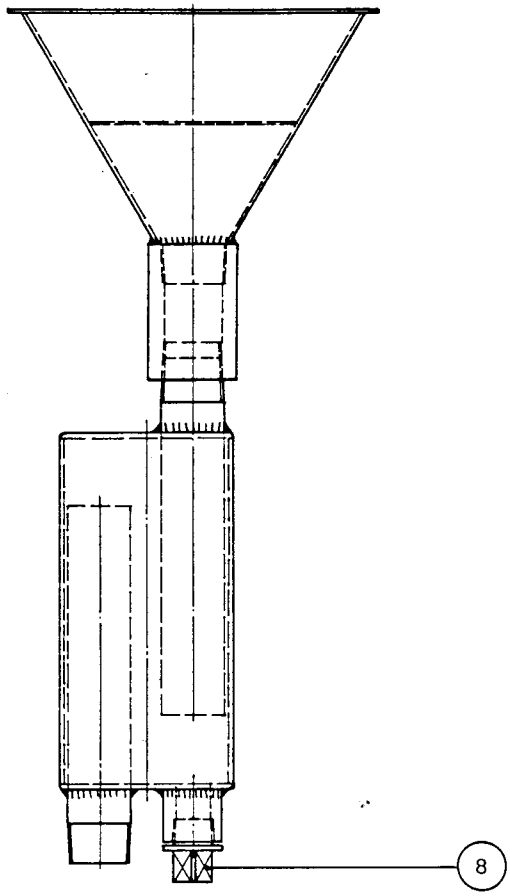
Engineering notes:

1. Connections N2 and N5 to be plugged off with hex. head plug - Material , ASTM A276 - Type 316 L.
   All other connections to be sealed with plastic caps during transport only.
2. Design in accordance with BS 5500 - 1982, (10% radiographing).
3. Vessel design pressure max. 14 bar (ga), design temperature **max. 200 °C.**
4. Dimensions in millimetres, unless otherwise stated.

VESSEL FOR TEST AND CALIBRATION SERVICES (cont'd)

APPENDIX 6 FUNNEL AND SYPHON





Item	Qty.	Description	Material	Remarks
1	1	Cone	AISI 316	
2	1	Grid	ASTM A-240 type 316	
3	1	Coupling 1/2" NPT 3000 lb.	ASTM A-403-type 316	
4	2	Flat cover	ASTM A-240-type 316	
5	2	1/2" line pipe schedule 40 S	ASTM A-312-type 316	
6	1	2" line pipe schedule 10 S	ASTM A-312-type 316	
7	1	Half coupling 1/4" NPT 3000 lb.	ASTM A-403-type 316	
8	1	Plug 1/4" NPT	ASTM A-403-type 316	

Engineering notes:

1. The type of supporting shall be designed by the manufacturer/supplier.
2. When specified, the funnel and syphon shall be made up from PVC.
3. Dimensions in millimetres, unless otherwise stated.

FUNNEL AND SYPHON (cont'd)

APPENDIX 7 COMPONENTS OF THE SAMPLE CONDITIONING SYSTEM

The Item numberrs refer to the drawings of Appendix 2.

Item	Description	Size	Item	Description	Size
06	Ball valve	0 12 mm OD 0 1/2 in OD	25	Removable filter	0 6 mm OD 0 1/4 in OD 0 1/4 in BSPP 0 1/4 in NPT
07	Isolate/vent valve	0 1/2 in BSPP 0 1/2 in NPT	26	Coalescer	0 1/4 in BSPP 0 1/4 in NPT
08	Globe valve	0 12 mm OD 0 1/2 in OD	27	Filter/coalescer	0 1/4 in BSPP 0 1/4 in NPT
09	Ball valve	0 6 mm OD 0 1/4 in OD	29	In-line filter	0 6 mm OD 0 1/4 in OD 0 1/4 in BSPP 0 1/4 in NPT
11	Needle valve	0 6 mm OD 0 1/4 in OD	31	Pressure regulator	0 1/2 in BSPP 0 1/2 in NPT
12	Check valve	0 12 mm OD 0 1/2 in OD	32	Back-pressure regulator	0 1/2 in BSPP 0 1/2 in BPT
			33	Regulator (steam)	0
13	Check valve	0 6 mm OD 0 1/4 in OD	34	Filter/regulator	0 1/4 in BSPP 0 1/4 in NPT
15	Ball valve 3-way	0 6 mm OD 0 1/4 in OD	35	Pressure regulator	0 1/4 in BSPP 0 1/4 in NPT
			36	Back-pressure regulator	0 1/4 in BSPP 0 1/4 in NPT
16	Relief valve	0 1/2 in BSPP 0 1/2 in NPT	38	Pressure gauge	0 1/2 in BSPP 0 1/2 in NPT
17	Relief valve	0 6 mm OD 0 1/4 in OD 0 1/4 in BSPP 0 1/4 in NPT	46	Flow meter	0 1/2 in BSPP 0 1/2 in NPT
22	Strainer	0 1/2 in BSPP 0 1/2 in NPT	47	Flow meter (with needle valve)	0 1/2 in BSPP 0 1/2 in NPT
23	By-pass filter	0 1/2 in BSPP 0 1/2 in NPT	48	Flow meter (with needle valve)	0 1/4 in BSPP 0 1/4 in NPT
24	By-pass filter	0 1/4 in BSPP 0 1/4 in NPT	49	Flow meter	0 1/4 in BSPP 0 1/4 in NPT

NOTE: Select the component required by placing a X in the 0

COMPONENTS OF THE SAMPLE CONDITIONING SYSTEM(Continued)

Item	Description	Size			
52	Flow controller	0	1/8	in	BSPP
		0	1/8	in	NPT
		0	1/4	in	BSPP
		0	1/4	in	NPT
53	Excess flow valve	0	1/8	in	BSPP
		0	1/8	in	NPT
		0	1/4	in	BSPP
		0	1/4	in	NPT
61	Temperature gauge	0	1/4	in	BSPP
		0	1/4	in	NPT
71	Sample valve (change over)	0	.....		
		0	.....		
72	Funnel	0	1/2	in	BSPP
		0	1/2	in	NPT
73	Calibration vessel	0	.....		
75	Syphon	0	1/2	in	NPT
76	Sight glass	0	1/2	in	BSPP
		0	1/2	in	NPT
81	Sample pump	0	.....		
86	Gas drier	0	.....		
87	Separator incl. manostat	0	.....		
89	Bubbler/manostat	0	1/4	in	BSPP
		0	1/4	in	NPT
90	Manostat	0	1/8	in	BSPP
		0	1/8	in	NPT