TECHNICAL SPECIFICATION

FIRE-FIGHTING VEHICLES AND FIRE STATIONS

DEP 80.47.10.33-Gen.

June 1993
(DEP Circulars 34/97 and 68/97 have been incorporated)

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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1. INTRODUCTION

1.1 SCOPE

This DEP is a revision of that with the same title and number dated August 1983. In Part I of this DEP proposals are given for a number of basic vehicles equipped with a selection of fire-fighting systems; these vehicles are illustrated in the Standard Drawing series S 88.1xx. If the types of fire-fighting vehicles required are not included in this DEP, a combination of the various facilities described should be considered.

Part II of this DEP covers the design of fire stations. Typical layouts are included for a small to medium-size refinery, and a large refinery, see Appendices 9 and 10.

Excluded from the scope of this DEP are rapid intervention vehicles used on airfields under ICAO regulations (refer Part I, 1.1).

1.2 DISTRIBUTION, APPLICABILITY AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIPM, the distribution of this document is confined to companies forming part of or managed by the Royal Dutch/Shell Group, and to Contractors and Manufacturers nominated by them (i.e. the distribution code is "F" as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants, and, where applicable, in exploration and production facilities.

If national and/or local regulations exist in which some of the requirements are more stringent than in this manual, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

1.3 CROSS REFERENCES

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

All publications referred to in this document are listed in Part III.

1.4 DEFINITIONS

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may 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. Except where modified (e.g. 'chassis manufacturer', 'superstructure manufacturer', etc.) the term Manufacturer is intended to mean the party receiving the order from the Contractor and who retains responsibility for the performance of the completed fire fighting vehicle.

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 authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.5 ABBREVIATIONS

ABS	Anti-locking Brake System
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BS	British Standard
CAA	Civil Aviation Authority
DCP	Dry Chemical Powder
DIN	Deutsches Industrie Norm
GRE	Glass Fibre Reinforced Epoxy
GRUP	Glass Reinforced Unsaturated Polyester
ICAO	International Civil Aviation Organization
ISO	International Organization for Standardization
MESC	Material and Equipment Standards and Code
NEN	Nederlandse Norm
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NST	National Standard Thread
PEFS	Process Engineering Flow Scheme
PTO	Power Take-off
RAL	Reichs Ausschluss für Lieferbedingungen
RQV	Regler Quer Volldrehzahl (load independent revolutions governor)
UN	United Nations

PART I FIRE-FIGHTING VEHICLES

1. GENERAL CONCEPT

The Manufacturer shall implement a quality system meeting ISO 9001 requirements (or equivalent standard if approved by Principal).

The Manufacturer shall keep a traceable record of all quality control tests performed and shall maintain this record for a minimum period of five years from the date of manufacturing.

1.1 FIRE APPLIANCE SIZING

The determination of required volumes of foam concentrate, DCP and water shall be based on the largest pre-fire plan (Refer to report: MF 92-1575, Paper 204).

Bearing in mind the available number of vehicles, the required volumes for each vehicle shall be indicated in the requisition. It is the Manufacturer's responsibility to engineer an appliance covering at least these volumes; while at the same time meeting all other requirements of this DEP.

In case no volumes can be determined, the figures mentioned in this DEP may serve as guidance.

It shall be noted that the requirements (operating envelope) of the various types of appliances (e.g. industrial fire fighting vehicle versus airfield crash tender) may vary greatly. In fact it is not unlikely that they are opposing. As a result it is unrealistic to expect that accomodating all requirements into one vehicle will result in a "fit-for-purpose" appliance.

1.2 THE VEHICLE

The fire-fighting vehicle shall consist of a chassis with a superstructure, and it shall be designed for industrial purposes with an expected lifetime of 20 years and in accordance with local authority regulations.

To be able to drive on site roads the maximum vehicle width shall be 2.5 m. For safety purposes the vehicle's sides shall be equipped with obstacle reflectors.

The vehicle shall function primarily on a fire water circuit (from hydrants) with a pressure of 6-16 bar (ga), see DEP 80.47.10.31-Gen. Certain vehicles shall, however, also be provided with facilities and equipment for suction from open water.

The vehicle shall be suitable for use in areas specified by the Principal.

The vehicle shall be able to carry all of the equipment specified in the requisition and to tow at the same time a trailer with a mass of at least 5 t.

It is essential for countries where local traffic regulations exist for overall weight, axle weight, power/weight ratio, lighting, etc., that this should be stated in the exchange of information with the Manufacturer.

Static calculations for axle/wheel load, centre of gravity and tilting stability shall be made and shown to comply also with the chassis manufacturer's requirements.

The vehicle shall be of open construction to assist visual inspection, maintenance and repair. The equipment used for water/foam systems shall be located so that it will be readily accessible. Fire-fighting systems shall be simple and easy to operate, to facilitate training of personnel and use in an emergency.

The angle of approach and departure (refer NFPA-1901) shall be at least 15 degrees. Assuming the lowest point of the vehicle is the underside of the differential housing bowl, the clearance to the underside road surface shall be minimum 300 mm.

The installation of mechanical, electrical, pneumatic and hydraulic components shall be located in such a way that dismounting or repair is not obstructed by the chassis structure or any other component, and electrical wiring and pneumatic tubing is not damaged while operating the vehicle. The electrical system shall be dustproof and waterproof (see 1.8).

Installation drawings (PEFS's, General Arrangements, tank details, etc.) of the water, foam and DCP systems indicating location of the flanges, connections, valves, drains, etc., shall be provided by the Manufacturer for approval and comments by the Principal. Storage cabinet lay-outs shall be included.

Monitoring inspection during construction shall, if specified by the Principal, be carried out by the Principal. Road tests and performance testing of all fire-fighting systems shall form part of the final inspection for acceptance prior to delivery (5).

Manufacturer's proposals shall indicate any deviations from the requirements given in this DEP. For the Manufacturer's guidance the quotation requirements are listed in (2.10).

1.3 CHASSIS, STEERING AND BRAKES

The chassis shall be standard commercial type, commonly available and serviceable in the country of destination, having a local spare parts supply. The chassis shall consist of a steel structure, at least four wheels and two axles. If self propelled it shall have an engine, hood, and cab.

The chassis shall be provided with towing connections at the rear and at the front; the additional forces when using these connections shall be considered in the design.

In order to negotiate street corners on site, the chassis should have a wheel base of no longer than approximately 4 metres.

A single rear axle should be fitted, unless local regulation limits on axle loading make a double rear axle necessary. In the latter case, a non-retractable dual rear axle shall be applied.

The choice of suspension shall reflect the vehicle's condition of being continuously fully loaded.

The transmission shall drive a rear single axle only, unless the Principal specifies that both front and rear axles are to be driven. It should be possible to lock all differentials to assist driving in difficult terrain conditions.

Steering shall be hydraulically power-assisted; left or right hand drive.

The brake system shall be of the positive air type and should be equipped with an ABS. The air pressure shall release the brakes no more than 30 seconds after the engine has started, even if a trailer is connected. The braking system shall comply with UN-agreement E/ECE/324-E/ECE/TRANS/505 - Addendum 12, Regulation 13.

The compressed air system shall be of sufficient capacity to supply air for all fixed-installed systems on the vehicle. To keep the brake system pressurised a 1/4-in. connection for an external air supply shall be provided at the rear of the vehicle. The connection shall be of the quick connect type with a drive-away/pull-out facility; the body material shall be of aluminium brass or stainless steel.

The chassis shall be equipped with:

- wheels, fitted with radial tyres suitable for wet roads or, if specified, suitable for off-the-road conditions, and mud flaps (front and rear);
- fuel tank, 200 litres minimum capacity, with the capability of refilling during operation;
- air pressure vessel, fitted on the inside of the chassis if necessary to provide space for lockers or other superstructure details;
- stabilizers on front and rear axles;
- spare wheel, tools and jack (to be supplied as standard equipment but not carried on the vehicle unless specified in the requisition);
- 24 V battery system - two 12 V/110 A h (minimum) batteries in series;
- main battery switch, double pole type, operated from the inside and the outside of the cabin;

- pneumatic braking connections in accordance with ISO 1728;
- a socket for trailer lighting in accordance with ISO 1185.

1.4 ENGINE

The vehicle shall be driven by a diesel engine which is also capable of providing power to the installed water/foam system when stationary. The diesel engine should be a 6 cylinder and it shall be provided with:

- an adequate cooling system of sufficient capacity to prevent overheating e.g. during stationary use in tropical areas in combination with prolonged fire fighting under full operational conditions of both water and foam pumps (maximum ambient temperature shall be specified by the Principal). The cooling fluid shall be a high-efficiency cooling medium with an anti-corrosion additive.
- if specified, an electric heating element, with a thermostat in the cooling system, to facilitate immediate optimum performance upon starting the engine in extremely cold conditions.
- a synchro-mesh gearbox or, if specified, an automatic gearbox with an oil cooler. The gearbox shall be fitted with a switch to operate the reversing lights and an on-off buzzer when reverse gear is engaged. If an oil cooler is to be supplied, a connection for a temperature indicator shall be provided.
- a PTO transmission for the water booster pump.
- a PTO transmission for the foam pump, unless the pump is driven from a different source.

  PTOs should be electrically/pneumatically engaged from the driver's cabin and, if specified, from the operating panel. Manual engagement of the PTO may be specified if required.

  The PTOs shall be selected to transmit the torque and power required by the booster and foam pumps when rotating at the required engine speed with all discharge branches completely open. A duplex PTO may be used to drive the water booster and foam concentrate pump.

  NOTE: Particularly in combination with an automatic gearbox, a "fool-proof" logic control device shall be installed to ensure:

  - parking brake is applied before engaging PTO
  - engine rpm is at correct level before engaging any of the PTOs
  - proper engaging sequence to engage and to disengage PTOs.
- an RQV regulator (automatic revolution regulator).
- an exhaust pipe, with spark arrestor(s) of an approved type, which should be located in front of the front wheels or aiming vertically upwards behind the cab and in such a way that it complies with local regulations.
- an automatic overspeed protection of an approved type for the diesel engine, by means of an automatic shutdown valve in the air intake system. This protection shall shut down the engine in the case of intake of flammable gas.
- dust filters for the engine's air intake shall be specified in the requisition (for desert or unusually dusty areas).

1.5 CABIN

1.5.1 General

The framework of the driver's cab shall be of metal construction, covered tightly on the outside with metal plate. If specifed, a ventilation hatch in the roof shall be provided.

The framework shall be mounted on shock absorbers and be of such construction that harmful stresses will not occur during normal use.

To ensure that the crew will be offered maximum protection in case of an accident, the cab should comply with the "UN Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts" (E/ECE/324 - E/ECE/TRANS/505):

- Protection of the Occupants of the Cab of a Commercial Vehicle (including roof and rear wall strength: Addendum 28, Regulation 29
- Strength of Seats, their Anchorage and Head Restraints: Addendum 16, Regulation 17 (vehicle type M1 to be read as vehicle type N3)
- Safety Belt Anchorage: Addendum 13, Regulation 14
- Safety Belts: Addendum 15, Regulation 16.

Adequate measures shall be incorporated for the strength of the doors and door frames in case of a side-on collision.

Consideration shall be given to protection of the cabin during a roll-over.

The maximum noise level in the cab (under full load conditions) shall be maximum 85 dB(A) as measured in accordance with ISO 5128.

1.5.2 Floor

The floor of the cab shall be treated with an anti-resonance material. The floor of the driver's compartment shall be covered with a fixed rubber-type material, the top coat of which shall be non-sliding, wear resistant and water repellent.

1.5.3 Doors

The cab shall be provided with two doors, constructed and suspended in such a way that they provide easy access into and out of the vehicle for the crew in 'turn out' clothing.

The doors shall be treated internally with an anti-resonance material and be protected with an anti-corrosive coating.

The windows shall be weatherproofed with rubber strips.

There shall be drain holes in the bottom of the doors. The door handles shall be made of non-corrosive material and they shall not protrude or have openings facing forward.

1.5.4 Windscreen

The windscreen shall be of laminated safety glass with the upper 20-30% tinted either by integration or by means of a self adhesive strip. The driver shall be given as wide a view as possible from the cab to all sides. The windscreen shall be fitted with at least two wide arc wipers having two speeds, and an electrically operated screen washing system with at least two nozzles.

1.5.5 Sunscreen and sunshades

The driver's cab shall be fitted with a sunscreen fitted along the top of the windscreen on the outside. Two adjustable sunshades shall be provided on the inside.

1.5.6 Mirrors

The cab shall be equipped with driving-mirrors on the right and left sides of the vehicle plus a parking mirror on each side. The mirrors shall be adjustable, free from vibration and fastened in such a way that they cannot move out of position under normal driving conditions.

1.5.7 Steps

The steps of the cab shall not protrude outside the vehicle width, they shall be made of non-corroding material, and have a non-slip surface (not rubber).

1.5.8 Seats - Front

The driving cab shall have seats for 3 persons, covered with heavy-duty leatherette. The seats shall be fitted with inertia reel safety belts, fixed at 3 points for the outer seats and fixed at 2 points for the middle seat.

1.5.9 Lighting and siren

All lighting shall conform to applicable local standards, to suit right-hand or left-hand drive as required and be installed as follows:

- an internal light (minimum 15 W) with on-off switch, fitted in the roof of the cab; it shall also operate on the opening and closing of the doors
- a map reading-light fitted to the dashboard next to the driving seat
- one long-range search light at the front of the vehicle
- twin reversing lights at the rear of the vehicle, operating automatically on selection of reverse gear
- floodlights
- revolving beacons with halogen bulbs, the colour of the beacon to be specified by the Principal
- searchlight
- fog lamps with protectors against flying stones, fitted at the front of the vehicle if required.

A two-tone siren shall be provided.

1.5.10 Ventilation

Air vents shall be distributed across the width of the dashboard in order to demist the windscreen and windows of the front doors. The vents shall have adjustable outflow openings on the left-hand and right-hand side of the dashboard. The vehicle shall be fitted with a blower having at least two speeds. For tropical climates, a high-capacity ventilation system shall be provided.

1.5.11 Heating

The cab shall be equipped with an adjustable heating system capable of achieving and maintaining a temperature of 15 °C ± 2 °C inside the cab within 20 minutes, when the outside temperature is -15 °C.

For extremely cold (e.g. arctic) climates a heating system shall be provided which is independent of the engine.

1.5.12 Cooling

If prolonged driving is required under tropical/desert conditions, the installation of a standard air conditioning unit should be considered; if installed the air conditioning unit shall use a cooling medium with minimum or no ozone depletion potential. If an air conditioning unit is installed, it also requires the installation of a battery and alternator with increased capacity.

1.5.13 Dashboard

Notwithstanding the switches supplied by the chassis manufacturer the dashboard shall contain switches for the following:

- revolving beacons and siren
- fog lamps, if required
- floodlights
- compartment/cabinets lighting (as a master switch)

- map reading-light
- switch for heating element in the cooling system, if applicable
- electrical main switch (inside the cab with a second switch outside for emergency use)
- engaging PTO's.

The function of each switch shall be indicated in white text and symbols engraved on black plates in the language or in symbols provided by the Principal. (Ref. ISO/DIS 10085).

The dashboard shall also contain indicators for the following:

- engine cooling water temperature
- lubricating oil pressure
- fuel tank level
- charging current
- brake air pressure
- engaged signal for each PTO.

1.5.14 Portable search light

Two portable search lights (5 W) shall be installed in the cab. The lights shall be suitable to operate in a Hazardous Area classified as Zone 1 (refer to IP Model Code of Safe Practice-Part 15). The automatic charging device shall be connected to the vehicle's electrical system.

1.5.15 Mud guards

A mud guard and a mud flap shall be fitted to each wheel. The underside of the superstructure shall not be used as a mud guard.

1.5.16 Mobile radio

Sufficient space shall be provided to install a rack containing a mobile radio. The Principal shall specify the make and type of radio and its required voltage (refer to DEP 32.71.00.10-Gen.) and the required dimensions of the rack.

A cable shall be installed to provide electrical power from the appliance battery to the radio. In addition, a cable shall be installed to connect the radio to the remote handset and speaker located at the rear water/foam operating panel (refer 2.2.9).

The aerial shall be installed on the cabin roof for optimum performance.

A dedicated loudspeaker shall be installed in the cabin.

The hand-held microphone shall be equipped with a push-to-talk button.

The radio set and microphone shall be within reach of the driver.

1.6 EXTENDED CAB

1.6.1 General

The extended cab shall be made in two separate sections, comprising a tilting standard driver's cab and a crew compartment, fixed to the chassis.

If the crew compartment is constructed immediately behind the driver's compartment, an elastic seal shall be fitted between the rear wall of the tilting driver's compartment and the front wall of the fixed crew compartment. This seal shall be draughtproof and waterproof under any driving condition, and the permissible sound level within the cab shall not be exceeded.

The roof of the crew compartment should be covered with aluminium ribbed sheet and be strong enough to carry at least one person in case a top-mounted monitor is provided.

The compartment shall be fitted with doors, and a two-way communication system with the driver shall be provided.

1.6.2 Seats

The Principal shall specify the required option, depending on the number of crew.

Examples of options are:

- one bench (4 seats)
- one bench and two separate (folding) seats
- two benches (8 seats).

All seats should be equipped with seat belts, see (1.5.1).

1.6.3 Mounting brackets for breathing air apparatus

The construction and attachment of brackets for breathing air apparatus shall be robust and be fitted in such a way that brackets and apparatus do not break loose during maximum braking retardation.

The location and number of the mounting brackets and type of equipment shall be specified by the Principal.

1.6.4 Floor

The floor of the crew compartment shall be covered with chequered aluminium plates or other equivalent non-slip material.

1.7 SUPERSTRUCTURE

The equipment compartments, foam tank, pump, and powder units shall be attached to the chassis beams by a method which will prevent harmful influence, ensuring flexibility of the body work superstructure and good road grip for the wheels.

The interface of the superstructure/body mounting frame and chassis shall conform to the specification of the chassis manufacturer.

Two or more cabinets of minimum depth 550 mm shall be fitted on each side of the foam tank for the storage of portable fire-fighting equipment. If specifed all cabinets should be closed by roller shutters which are self-locking in any position or, if specified, hinged doors opening upwards.

Separate compartments with shelves shall be provided for the storage of individual fire hoses; suction hoses shall be located in racks on top of the compartments. Taking into account local ergonomic requirements, fixed or hinged steps and/or ladders shall be provided for access to hoses and equipment. All cabinets and racks shall be self-draining with the cabinet floors made of corrosion resistant material.

Generally all horizontal top surfaces (e.g. operating platforms and tank roofs) require regular access. Therefore a railing (minimum height 300 mm) shall be provided around surfaces such as top of cabinets, hose compartments and tanks.

1.8 ELECTRICAL SYSTEMS

The vehicle shall be equipped with the following electrical systems, in accordance with statutory regulations, dust and waterproof to at least a minimum of IP 55 in accordance with IEC 529 and, if required, suitable for tropical conditions:

- Plug and socket, 4-pole, for a battery charger; in accordance with DIN 72575. The plug and socket shall be manufactured from an approved non-metallic material and be of the pull-out-and-drive-away type, i.e. socket cover to be sawn off.

  A wall-mounted, constant voltage type of battery charger shall be specified. It shall be fitted with overload protection and an automatic cut-out device for controlling the charging of the batteries. In addition, as close as possible to both batteries' positive

terminals, a fuse shall be installed in each charging conductor. The socket shall be located at the rear of the vehicle so that the plug is automatically pulled out of the socket when the vehicle drives away. The plug will then fall to the ground.

NOTE: The battery charger supplied shall be wall-mounted in the fire station. The electric supply should be 110 V or 220/240 V, 50-60 Hz as specified.

- Lighting, installed over the water booster pump and elsewhere positioned such that all gauges, operating handles, operating panels and their surroundings are properly illuminated. This lighting shall be switched on and off by a control switch in the driver's cabin and also from the control panel for operations at the rear of the vehicle. The lighting in the storage cabinets shall operate automatically on opening and closing of doors and shutters. Light fittings in compartments shall also be in accordance with IP 55 to IEC 529. All lighting shall be protected against mechanical damage.
- Detachable flood light (70W/24V) at each side of the driver's cabin, with plugs and sockets. The sockets shall be 2-pole, screwed connections, in accordance with DIN 14690. Material shall be aluminium.
- A red, or other colour if specified, revolving beacon with halogen lamp at left and right-hand side. | installed on top of the driver's cab
- An adjustable (from passenger position) searchlight.
- A double-tone siren with a minimum noise level of 100 dB(A) at 5 m.
- An amber, or other colour if specified, revolving beacon at the rear of the vehicle, normally positioned on the left for left-hand drive vehicles.
- Two adjustable floodlights, also to be used as reversing lights, at the rear.

  NOTE: Working lights (floodlights and search lights) shall be adjustable both horizontally and vertically.
- A connection for trailer lighting, 24 V DC in accordance with ISO 1185.
- A connection with a 24-core, or as otherwise specified, screened cable for operating the cab-mounted mobile radio from the operating panel.
- All additional electric cables and wiring installed on the chassis shall be run in conduit.
- The colour or identification code used for electric wiring should be in accordance with the requirements of the country of origin of the vehicle.
- Audible reversing signal with appropriate octave band (refer to 2.2.10 and ISO 7731).

2. FIRE-FIGHTING SYSTEMS FOR INSTALLATION ON THE FIRE-FIGHTING VEHICLE

2.1 GENERAL

Depending on the application, the vehicle shall be provided with a water/foam system or a dry powder system, or both. The minimum requirements for each system are given below.

When the vehicle is fully loaded with a full crew and the major items of equipment, chemicals (and water), it shall be possible to add at least 500 kg of portable equipment, without exceeding 95% of the permissible load on the chassis. The Manufacturer shall provide the detailed load calculations for the vehicle and for each axle, so that compliance with the above requirement can be checked. For some vehicles more than 500 kg of portable equipment may be required.

The overall load shall be equally distributed over the front and rear axles and symmetrically distributed over the right and left-hand side wheels.

Under all circumstances the rear axle shall never be subjected to more than 75% of the total load.

In addition the centre of gravity of the fully loaded vehicle and the corresponding static tilting angle shall be calculated assuming no spring and no tyre deflection.

Under full load conditions the chassis should be in the horizontal position. A vertical/upward deviation of 25 mm measured at the rear end of the chassis beam is permissible.

The Manufacturer shall also indicate the expected deviation in the loaded condition, **but without** the weight of water and foam.

The type of liquid hose couplings shall be specified in the requisition and should be selected from the following:

- Breechlock (Storz, NEN 3374 or DIN 14300 - Series, type to be specified in accordance with local standards)
- Instantaneous, in accordance with BS 336
- American fire hose coupling thread (NST)

However, the couplings for suction from open water and for foam concentrate hose connections should be breechlock (Storz).

Size for normal duties : $2\ ^1/_2$ inch or, if specified, 65 mm

For suction from open water : 5 (or 6) inch or, if specified, 125 (or 150) mm.

If blind caps are required, they should be non-metallic with two 3 mm drain/vent holes. Blind caps shall be secured to the connectors (couplings) with plastic sheathed steel wire rope.

The Manufacturer shall provide a stainless steel identification plate with the following information:

- order number
- serial number
- delivery date
- supplier's name and country of manufacture.

The plate shall be attached at the rear of the vehicle and be clearly visible.

Modifications to chassis members and/or to the drive angle of PTOs, as originally determined by the chassis manufacturer, shall be in accordance with the chassis manufacturer's instruction, unless otherwise approved by the Principal.

During all stages of the engineering process due attention shall be paid to ergonomic aspects in relation to the occurrence of the various modes of operation.

2.2 FIRE-FIGHTING WATER AND FOAM SYSTEMS

2.2.1 General

The water/foam system shall include at least the following modes of operation.

- Water supplied from hydrants through the vehicle manifold, by-passing the booster pump, with the addition of foam concentrate.
- Water supplied from hydrants via the booster pump to the discharge connections, with the facility to add foam concentrate at each individual discharge connection.
- If required, water taken by suction from open water, via the booster pump, to the discharge connections, with the facility to add foam concentrate at each individual discharge connection.
- Each discharge connection shall be suitable for water and for foam solution.
- Foam concentrate shall be added via proportioners in each individual discharge connection, the foam concentrate percentage shall be manually adjustable between 0 and 6%, whereby the automatic balanced pressure control foam proportioning shall be equipped with a manual override (by-pass).
- Delivery of foam concentrate under pressure from the foam concentrate tank to fixed-installed systems (e.g. inductor or storage facility).
- If a water tank and foam concentrate tank are installed on the vehicle the water, with or without adding foam concentrate, shall be passed via the booster pump to the discharge connections.
- If specified it shall be possible to drive the vehicle for a limited period with a speed of 5 km/h on a road of given slope (with an inclination to be specified by Principal), when both the water and foam concentrate pump are operating.

The above design criteria shall be met by using approved equipment and components in an efficient manifold arrangement.

2.2.2 Water/foam capacities

The equipment and piping shall be selected and designed such that it will meet the following requirements as a minimum:

TABLE 1

Application	Source of water supply	Water rate dm^3/min		Water pressure bar (ga)		Foam concentrate dm^3/min		
						min.	max.	
							1% setting	6% setting
		min.	max.	suction	disch.			
Foam solution or water	Direct from hydrants (by-passing the booster pump)	400	7800	6-12	(Note 2)	4	78	468
	From hydrants via the booster pump	400	4500	6-12	11-16 (pump diff. head 5 bar ga) (Note 4)	4	45	270
	Suction from open water via the booster pump (Note 3)	400	2400	1.5 m suction height (Note 1)	10	4	24	144
	Suction from water tank on vehicle via the booster pump	400	2400	Atm.	10	4	24	144
Foam concentrate to discharge (16 bar ga)	-		-			4	-	500

NOTES:
1. Suction from open water at a temperature of 15 °C specified at a suction height of 1.5 m and atmospheric pressure of 1035 millibar.

   The Manufacturer shall specify the discharge rate and pressure at 3.0 m and 6.0 m suction height.

2. Piping component dimensions shall cater for a typical 2 bar (ga) pressure drop across the vehicle at a flow of 7800 dm^3/min and a maximum inlet pressure of 10 bar (ga).

3. The priming system of the booster pump shall have a capacity such that at 3.0 m suction height the booster pump will be fully operational within 25 seconds when a 6 m length of suction hose is connected.

4. The Manufacturer shall state the minimum required vehicle inlet pressure in continuous boosting mode to achieve a flow of 6000 dm^3/min at an outlet pressure of 12 bar (ga).

GENERAL NOTES:
a) The Manufacturer shall provide marked-up certified pump curves at the selected r/min (engine pump speed) including the condition of fully open discharges. A list shall be included to show the required power-r/min-torque in accordance with DIN 6271 for all the specific conditions at rated flows and with fully open discharge.

b) Filling rate of foam tank is 20 dm^3/sec minimum.

c) The pump installation shall be airtight down to 0.2 bar (abs) with the priming pump stopped, and 0.4 bar (abs) shall be maintained for a period of at least 2 minutes.

2.2.3 Foam control system

The foam proportioning system shall be designed such that foam agent can be added at each individual discharge connection. The in-line proportioners shall have a minimum

rangeability of 400 to 1300 dm^3/min but should have a rangeability of 200 to 1500 dm^3/min.

It shall be possible manually to set the foam percentage at zero and proportionally between 1 to 6%. This should be continuous but in any case shall be in steps not greater than 1%. Therefore the proportioning valve shall be provided with a clearly marked scale.

The in-line proportioners shall be calibrated in the actual manifold on the vehicle as follows:

- calibration: at water rates of 400 and 1200 dm^3/min
- foam setting: normally 3% unless otherwise specified
- required accuracy: within 0 and plus 10% of nominal setting.

The Manufacturer shall provide a copy of calibration curves for the type of applied proportioners which show the accuracy at 1, 2, 3, 4, 5 and 6% and indicate the effect when used with foam agents of different viscosities such as fluoroprotein, film forming and alcohol-resistant foams and multi-purpose (pseudo plastic/non-Newtonian) concentrates (refer to DEP 80.47.10.10-Gen).

2.2.4 Water booster pump

The pump shall be of the centrifugal type, fitted at the rear of the chassis except if otherwise required, see (3.19), and be installed in such a way that there will be no axial force on the driving shaft when in operation.

The pump shall be driven by a PTO, have a separate automatic priming system and be able to fulfil the characteristics given in Table 1. The pump shall also be provided with a filling funnel in an accessible place.

The material of the pump casing and casing wear rings should be copper alloy to ASTM B584-No. C 90500 with impeller and wear rings of copper alloy to ASTM B148-No. C 95800, or approved equivalent.

The shaft material shall be Monel K-500, with an austenitic Cr-Ni stainless steel sleeve (AISI 316), Colmonoy 6 coated. Proposed equivalent materials shall be subject to approval by the Principal.

The Manufacturer shall indicate the direction of rotation and shall advise on the type of glands, bearings and the material used as standard.

To safeguard the pump, a temperature controlled drain valve discharging to atmosphere shall be installed in the line-up. The capacity shall be such that if all manual discharge valves are closed, the water temperature will not exceed 60 °C under full load.

The Manufacturer shall provide a copy of the pump test curves.

2.2.5 Foam concentrate pump

This pump should be a positive displacement type and work independently (driven by a PTO or other source) of the water booster pump. The pump shall be able to fulfil the requirements given in Table 1 and be able to inject foam concentrate into the water stream at a pressure of 0.1 to 0.7 bar above the maximum water pressure, delivered by either the water booster pump or the fire water mains.

The pump shall also be able to transfer foam concentrate from drums or external storage tank into the vehicle's foam concentrate tank, and vice versa. The line-up shall be provided with a relief valve having a set pressure equal to the design pressure of the system and discharging into the foam concentrate tank. The relief valve's capacity shall be sized to handle the maximum flow with a fully blocked outlet.

Pumps, for foam concentrate transfer purposes only, shall comply with (9.9.1) and (9.9.2).

The following foam concentrate pump material combinations shall be used unless other material combinations are approved by the Principal:

Housing	Rotor	Shaft
"Ni resist" D_2 cast iron	"Ni resist" D_2 cast iron	Stainless steel (AISI 316)
Gunmetal	Phosphor bronze	Stainless steel (AISI 316)

The Manufacturer shall give the direction of rotation of the drive shaft, the type of glands and bearings and the materials used as their standard.

The Manufacturer shall provide a copy of the pump curves certified by an independent institute.

2.2.6 Foam concentrate tank and accessories

The tank volume should be as large as possible, but shall at least contain the volume as specified with a tolerance of 5%. In any combination of foam concentrate and water tank the ratio shall be 1:10 unless otherwise specified.

The tank and all tank components shall be non-metallic. For design and construction, see (2.5). In exceptional cases, a tank of stainless steel AISI 316 L may be applied, see (2.4).

To limit liquid movement the tank shall be provided with sufficient internal baffles, the sizes and spacing of which shall still allow for cleaning and inspection. The foam concentrate tank shall have an expansion dome with a volume of 3% of the tank volume, the dome shall be provided with a manhole of minimum diameter 500 mm, fitted with a quick-release lock for filling purposes.

The foam concentrate tank shall also be provided with two pressure/vacuum valves of sufficient capacity, and with readily accessible hand-operated ball valves for tank emptying and filling. The pressure/vacuum valves shall be installed on the expansion dome in order to avoid them clogging due to splashing of the liquid in the tank (e.g. during braking). Their size shall be suitable for a filling rate of 20 dm^3/sec.

An overflow outlet line shall be fitted, terminating under the vehicle, in case of overfilling. The location of the overflow line termination shall be such that the foam concentrate will not fall on any part of the chassis.

The tank filling connections shall be provided with strainers. These connections and the tank drain shall be fitted with hose couplings, having caps which should be non-metallic and attached by a plastic sheathed steel wire rope.

The tank shall be equipped with a level indicator (visible at rear of vehicle) and a low-level audible alarm which will be activated when a remaining level of 10% is reached. For non-Newtonian concentrates (refer DEP 80.47.10.10-Gen.) an electro-magnetic level indicator shall be used. For Newtonian concentrates a hydrostatic level indicator may be used (see Appendix 7).

Indicators shall be well-supported and protected against damage.

All inlet and outlet connections shall be flanged to ANS class 150 in accordance with ANSI B16.5. Flange requirements are described in (2.5.2).

The suction nozzle in the tank shall extend inside the tank to avoid pumping sediment which may have settled in the tank bottom. The suction nozzle shall be provided with a vortex breaker.

The tank shall be adequately supported, freestanding and be free to expand independently of other parts of the vehicle.

The tank shall be shipped empty.

2.2.7 Line-up and piping design of the water/foam system

Amended per Circular 34/97

The line-up shall be in accordance with the relevant flow scheme for the specified

vehicle, see Appendices 1 to 6. Drain valves, vent valves and valved flushing connections shall be provided to ensure proper flushing of all components.

The size of the piping shall be such that the velocity will not exceed 2.8 m/s in the suction lines and 6 m/s in the discharge and return lines.

All components and the piping shall be designed for a minimum working pressure of 16 bar (ga) and shall be able to withstand a test pressure of 1.5 times the maximum working pressure. The piping shall be at least schedule 10 S.

System fittings, other components and piping shall be based on seamless stainless steel type AISI 316 material, using flanged connections throughout in the main piping. With the exception of non-metallic flanges the flanges may be solid stainless steel raised face or carbon steel lap type with seamless stainless steel stub ends and welded on rings; the flange facing finish shall be in accordance with ASME/ANSI B16.5.

All hand-operated valves should be of the full bore ball type up to 3 inch and butterfly type above 3 inch. The butterfly valves shall be flanged or wafer type valve bodies installed between flanges. For sizes up to 2 $^{1}/_{2}$ in. valve bodies and trims shall be of stainless steel type AISI 316L. Valves 3 inch and larger shall be carbon steel to ASTM A216 WCC or WCB with a maximum carbon content of 0.25%, and they shall have a trim of stainless steel type AISI 316. For flanged carbon steel bodies, insulation gasket sets may be required.

The flanges shall have flexible graphite gaskets with tanged metal inserts (MESC 85.30.10) and stud bolts to ASTM A193 grade B7 with hexagonal nuts to ASTM A194 grade 2H.

For welding requirements, see (2.4).

Material certificates in accordance with ISO 10474 type 3.1.B shall be provided for all pressure-containing parts.

The foam proportioners and the by-pass of the foam control valve shall be installed at the rear discharge connections, be easily adjustable and with their settings clearly visible. Maximum discharge connection elevation to be 1200 mm above grade.

All valves shall be easily accessible and operable from the outside of the vehicle, and be provided with engraved nameplates (black letters on white background) with a clear functional description in the language specified in the requisition. In particular the "open" position of the (tank) suction valve handles shall be clearly visible.

In addition, piping shall be provided with arrows, indicating the direction of flow. The colour of the arrows shall be contrasting to the paint colour on which they are applied.

If instantaneous-type couplings to BS 336 are specified, the inlets shall be male and the outlets shall be female, and each connector shall have a single twist release; NST-type couplings shall have female swivel type inlets and male outlets. The inlet and outlet connections shall be of copper alloy material.

All inlet and outlet couplings shall be provided with engraved nameplates, having black text on a white background.

An inductive-type flow meter shall be provided in the water piping and it shall have an accuracy of no worse than 5% over the flow range 400 to 8000 dm^3/min.

2.2.8 Manually adjustable water/foam monitor

The water/foam solution discharge rate should be approximately 2000 dm^3/min at a monitor inlet pressure of 10 bar (ga) but may, unless otherwise specified, be up to typically 3300 dm^3/min. The minimum throw length at 10 bar (ga) shall be approximately 60 m for water and 50 m for foam. Under these conditions no foam shall fall on the ground within 20 m of the monitor.

If the discharge rate and throw trajectories are required to comply with a particular standard, e.g. NFPA or ICAO, this shall be specified in the requisition.

When operated as a water jet, the jet shall be able to reach the ground at 8 m distance from the vehicle. When operated with low-expansion foam, with expansion ratios between 8 and 10 to 1, the foam blanket template shall be at least 4 m wide at the close throwing distance.

For loading distribution purposes the water/foam monitor shall normally be mounted at the rear of the vehicle. From its storage point the monitor shall be able to rotate horizontally by at least 330 degrees in both directions. The monitor shall be able to rotate vertically down to a depression of at least 30 degrees and up to an elevation of at least 80 degrees. The monitor shall be provided with adjustable deflectors.

As it is difficult to ascertain effective water/foam application from the traditional position behind the monitor, a side-on view is necessary. Therefore a wireless monitor control facility shall be considered.

The remote control drives shall be electric and the drives shall be compatible with the vehicle's electrical system. A radio receiver unit shall be installed on the vehicle in order to operate the monitor from a portable control box (refer to DEP 32.71.00.10-Gen. for avoidance of frequency interference). The control box, equipped with carrier straps, shall be equipped with a battery providing electrical power for at least 1.5 hours. After use the control box shall be stowed on the vehicle in an automatic charging device.

The control box shall provide the following functions:

- power on/off
- battery condition indicator
- joystick for integrated elevation and rotation control (elevation and rotation speed approximately 12 degrees/second)
- open/close water supply valve
- open/close foam concentrate supply
- joystick for deflector control
- joystick for pressure (rpm) control.

Each controller shall have its functions engraved in the mounting plate next to the pertaining controller location.

NOTE: Control boxes suitable for hazardous area zones are considered not justifiable, therefore the control box shall be equipped with a clearly legible warning sign having the following text:

"WARNING: SUITABLE FOR OPERATION IN NON-HAZARDOUS AREAS ONLY."

For back-up purposes the monitor shall also be operable manually. Position setting shall be done by a lever or other acceptable methods; however, locking of the monitor in any desired position shall be possible. In this case the operator shall stand on a fixed platform with swing down type handrails of height 700 to 900 mm. When swung down the remaining railing height shall be at least 300 mm.

The water and foam supply shall be manually controlled and be operable near the monitor on the platform; a pressure gauge shall also be fitted near the monitor.

The monitor and the bearings shall be of copper alloy material. The barrel and deflector shall be made of stainless steel, GRUP (refer to 2.5.1) or aluminium .

NOTE: For trailer mounted water/foam monitors see DEP 80.47.10.32-Gen.

The maximum height of the loaded vehicle, normally not more than 3500 mm, will be determined by the monitor; the maximum permitted height shall therefore be specified.

2.2.9 Operating and control panel - water/foam

The main operating and control panel shall be mounted at the rear of the vehicle except if otherwise required.

The width of the panel shall be approximately 600-800 mm and consist of the following groups (refer Appendix 3). It shall incorporate as a minimum the following:

1. *'Wet' instruments (open panel plate)*

   - water inlet pressure (pressure/vacuum)
   - water discharge pressure
   - foam discharge pressure
   - water/foam differential pressure.

   In areas where freezing may occur, provisions shall be made to avoid freezing of instruments and their impulse lines during actual (outside) operations.

2. *Electrical instruments*

   - engine oil pressure
   - engine cooling water temperature
   - PTO oil temperature
   - engine speed (rpm) and hours counter
   - rate of total water flow-discharge.

   NOTES: 1. The hours counter shall operate only when the PTO is engaged.

   2. Indicator scales of 'wet' and electrical instruments above shall be provided with red markers for above maximum/below minimum range, and green shaded areas for normal operating range.

3. *Warning (lamp + audible alarm)*

   - low luboil pressure
   - high engine cooling water temperature
   - high engine luboil temperature
   - high gearbox - oil temperature (if additional oil cooler is fitted)
   - where applicable: water tank low level
   - water pump discharge - high (above 15.5 bar (ga))
   - fuel tank - low
   - battery charging current - low
   - foam tank low level.

   NOTE: A switch shall be included to override the last four (or, for vehicles with a water tank, the last five) audible alarms if operation is to continue.

Where applicable the alarm lights shall be installed above the relevant indicators.

The audible alarm noise level shall distinguish itself by the correct choice of octave band. For maximum noise levels, see (2.2.10). Refer to ISO 7731 for calculation methods.

4. *Simplified schematic*

   The panel shall show in an engraved graphic presentation the water and foam lines including open/closed indicator lamps for the important isolating valves (9 pieces), actuated by single proximity limit switches for open or closed position (switches shall be of a Principal approved type.)

   Only upon engaging any PTO shall the electrical power be made available to the status lights and warning lamps.

   The 'normal' presentation shall be indicated, i.e. water boosting from hydrants with foam injection: all lamps green.

   The panel shall be constructed from stainless steel plate suitable for outdoor tropical sun-exposed conditions (non-glare brushed finish).

   The panel shall house the following status lights and switches:

   Status lights

   - parking brake: on
   - PTO 1: engaged (water booster pump)
   - PTO 2: engaged (foam concentrate pump)

   Switches

   - rear working lamps on/off
   - panel illumination (incl. locker and compartment lights) on/off
   - lamp test (push button)

5. *Panel design criteri*a

- The indicators, lights and switches including the wiring of sections, shall be installed in a weatherproof box.
  All seals shall have a degree of protection of at least IP 55 of IEC 529. The applied wiring terminations shall be vibration proof.

  For a typical layout of the panel, see Appendix 3.

Lamp colours:	Safe - normal	:	Green
	Non-safe - alarm position	:	Red
	Warning	:	Orange

The panel shall be installed at an angle such that a standing operator can easily read the instruments, at an eye level position between 1500-1800 mm. All illuminated lamps with coloured lenses shall be clearly visible in direct sunlight.

All elements shall be conveniently grouped and clearly identified in black text and symbols engraved on white plates.

The language to be used for identification/instructions shall be as specified in the requisition.

6. *Telecommunications*

   The operator panel shall be equipped with a telephone hand set and loudspeaker both connected to the mobile radio. Both items shall be weather proof to at least IP 55 of IEC 529. The speaker shall provide sufficient power to be audible in an 85 dB(A) environment. The telephone hand set shall be equipped with a push-to-talk button (refer to DEP 32.71.00.10-Gen.).

   NOTE: For compatibility with the mobile radio equipment refer to (1.5.16).

2.2.10 Noise levels

Noise may interfere with speech communication and mental concentration of the appliance operator. The total sound power level (including audible alarms) shall not

exceed 85 dB(A) at a location one metre beyond the operating panel.

2.3 EXTINGUISHING DRY POWDER SYSTEMS

2.3.1 General

The fire-fighting vehicle may be equipped with dry powder units, depending on the type of vehicle and its application. The system should consist of the following:

- dry powder vessel with charging system
- nitrogen cylinders for expellent gas and flushing function
- hose reels with powder hose and trigger nozzle
- control/inspection and operating panel
- dry powder monitor, if required.

2.3.2 Dry powder

Urea-based potassium bicarbonate shall normally be used. Other types of dry powder shall be specified if required (refer to DEP 80.47.10.10-Gen).

A container will hold 70% by weight of urea-based powder compared to other dry powder.

The initial filling of dry chemical powder shall be included in the quotation. The dry powder vessels shall be shipped empty.

2.3.3 Powder vessel design

Generally the vessel's maximum operating pressure is 16 bar (ga); however this shall be confirmed by the DCP system supplier.

The system shall be designed and manufactured in accordance with the code specified by the Principal. Pressure vessels shall comply with DEP 31.22.10.32-Gen. or DEP 31.22.20.31-Gen. A formal approval certificate for the vessels is required and shall be signed by a pressure vessel Inspecting Authority approved by the Principal.

All inlet and outlet connections shall be flanged to ANS class 150 or 300 as required, with raised faces. Each vessel shall have a relief valve of sufficient capacity to ensure that the maximum pressure will not exceed the maximum operating pressure by more than 15%. Depending on the vessel size a manhole (minimum 24 inch) or inspection hole shall be provided. The inspection hole shall have a minimum diameter of 150 mm for powder filling purposes. Lifting lugs shall also be fitted.

After full discharge, the remaining quantity of powder in the vessel shall be less than 7% of the nominal charge.

2.3.4 Line-up and piping design of the dry powder system

Amended per Circular 34/97

The line-up shall be in accordance with the relevant flow scheme, see Appendices 6 or 8.

All valves shall be of the ball type, suitable for dry powder and be manually operated except if used with a monitor, see (2.3.7). The pipe system, branches, T-pieces and bends shall be smooth and have minimum resistance to the flow of dry powder. The fluid velocity shall be at least 2 m/s, but it shall not exceed 4 m/s unless otherwise approved by the Principal.

Each cylinder shall be provided with its own valve and be connected to a high pressure manifold, a manually operated valve should be fitted in the manifold. If an electrically/pneumatically operated valve is specified by the Principal, manual operation shall also be provided.

Sintered metal filters or check valves with synthetic rubber seals shall be fitted so that dry powder will not enter the gas system.

The piping shall be seamless carbon steel to ASTM A106 grade B, having raised face flanged connections to ANS class 150 or 300 as required, with a flange facing finish in accordance with ASME/ANSI B16.5.

The flanges shall have flexible graphite gaskets with tanged metal inserts (MESC 85.30.10) and stud bolts to ASTM A193 grade B7 with hexagonal nuts to ASTM A194 grade 2H. All hand-operated valves shall be of the flanged ball type having bodies of carbon steel to ASTM A216 WCC or WCB with maximum carbon content of 0.25%, trim of austenitic Cr-Ni stainless steel (AISI 304) and with fibre-glass or teflon reinforced seat rings.

For welding requirements, see (2.4).

The components of the pressurized system shall be pressure-tested at 1.5 times the maximum working pressure.

All equipment shall be easily accessible and provided with engraved nameplates (black letters on white background) with a clear functional description in the language specified.

Material certificates in accordance with ISO 10474 type 3.1.B shall be provided for all pressure-containing parts.

2.3.5 Expellent gas bottles

Sufficient dry nitrogen shall be available to empty each powder tank fully and to flush all piping. During operation the vessel pressure shall never be less than 14 bar (ga). The cylinder contents shall have a reserve of 30% in order to deal with possible small leakages during intermittent operation and to carry out control functions.

Pressurising time of the powder vessel, to reach minimum 14 bar (ga), shall be less than 15 seconds.

In order to avoid clogging of DCP in the system, the maximum water vapour level in the nitrogen shall not exceed 30 p.p.m.

2.3.6 Powder gun, powder hose, hose reels

The powder gun shall have a throw of at least 15 m and an output of 1.8 kg/s for urea-based DCP (refer to DEP 80.47.10.10-Gen.) or 2.5 kg/s for non urea-based DCP. For other outputs the hose diameter and the trigger nozzle shall be adapted.

The hand nozzles shall be of seawater-resistant bronze alloy (ASTM B171-C63000).

The dry powder hose, having electrically conductive properties, shall have a smooth bore of at least 25 mm diameter and it shall be at least 30 m long (refer ISO 4642). The safe working pressure and the bursting pressure of the hose shall be respectively 2 and 3 times the working pressure of the powder vessel. The hose reel shall have the least possible resistance. It shall be possible to unroll the hose under pressure without jamming; a manual rewind mechanism shall be provided. The hose reels shall have hose gliders and a brake blocking device.

At least 2 hose reels shall be provided on the vehicle.

2.3.7 Manually adjustable powder monitor

If a powder monitor is required, it shall be installed on the vehicle in such a way that the powder stream shall be able to hit the ground approximately 8 m from each side of the vehicle.

The powder monitor shall be manually operated and, depending on the type of DCP, its capacity shall be 20 kg/s with a throw between 30 and 50 metres.

From the straightforward position the monitor shall be able to rotate horizontally by at least 140 degrees in both directions. The monitor shall be able to rotate vertically down to a depression of at least 20 degrees and up to an elevation of at least 70 degrees

An operating device shall be installed at the monitor to open and close the quick-acting

main pneumatic valve of the powder tank. An override for manual operation shall be included.

The monitor shall be equipped with a reliable locking and braking device and a cover on the barrel (attached by a chain) to prevent water entry.

The monitor shall be operable from a fixed platform with swing down type handrails having a railing height of between 700 and 900 mm. In the swing down position the railing height shall be at least 300 mm.The maximum vehicle height, normally not more than 3500 mm, will be determined by the monitor. The maximum permitted height shall therefore be specified.

The monitor shall be made of seawater-resistant bronze alloy (ASTM B171-C63000) with a stainless steel (AISI 316) or GRUP barrel.

If the discharge rate and/or throw trajectories are required to comply with a particular standard, e.g. NFPA or ICAO, this shall be specified in the requisition.

The flushing valve for the monitor shall be located near the monitor.

2.3.8 Control and operating panel powder systems

A control/inspection and operating panel shall be fitted next to or near each powder unit, comprising the following items:

- flushing valve - hose
- powder valve
- pressure gauge for the expellent gas 0-250 bar (ga)
- pressure gauge for the working pressure 0-25 bar (ga)
- push button to pressurise the tank, if specified.

Text identification shall be engraved in the language specified by the Principal.

2.4 WELDING REQUIREMENTS

Amended Per Circular 68/97

Welders and welding procedures shall be qualified in accordance with ASME IX or equivalent standard approved by the Principal.

2.5 GLASS FIBRE REINFORCED EPOXY OR UNSATURATED POLYESTER RESIN LAMINATE TANKS

The tank shall be able to withstand salt/brackish/potable water and all foam concentrates (refer DEP 80.47.10.10-Gen).

Tank documentation shall provide detailed instructions for carrying out minor repairs at the place of destination (see 2.9).

2.5.1 Base materials

The tank and fittings shall be made from either:

- a bisphenol 'A' epichlorohydrin epoxy resin, e.g. "EPIKOTE 828" and an aromatic or cyclo-aliphatic amine-type curing agent (GRE)

  or

- isophthalic acid polyester resin, bisphenol 'A' polyester or vinyl ester resin (GRUP).

The Manufacturer shall state the type of resin and curing system chosen.

The glass fibre reinforcement shall be made of E-glass and shall have a coupling agent (finish) which is compatible with the resin system.

The glass fibre reinforced laminate shall consist of a resin-rich inner lining, followed by

layers of resin-impregnated glass fibre reinforcing and a resin-rich outer layer. The resin-rich layers shall be free of defects as per 2.5.3.

Only in the resin rich outer layer may fillers or pigments be used.

2.5.2 Design and fabrication

Amended per Circular 34/97

DEP 31.22.30.14-Gen. and DEP 31.22.30.34-Gen. shall apply except where modified by this DEP.

The selected type and design of the tank shall be fabricated with a self supporting bottom construction provided with shaped laminated support beams integrated with the bottom.

The tank shall be provided with transverse and longitudinal baffle plates which are integrated into the tank by means of lamination.

All flanges shall be made from GRE or GRUP. Nozzles shall be laminated into the tank wall. The flange facing finish shall be in accordance with ASME/ANSI B16.5.

The dynamic loading shall take into account a braking deceleration of 5 m/s^2 with the tank half full, and a centrifugal acceleration resulting from cornering a bend with a radius of 60 m. at a speed of 16.7 m/s (60 km/hr).

The top of the tank shall be designed such that personnel are able to walk thereon. An ultra-violet stabilised anti-slip layer finish shall be applied. The tank roof shall be self draining. To allow the installation of a safety railing, a roof edge shall be laminated to the tank.

The tank design, indicating the type of basic materials for construction, including the construction procedure and strength calculations, shall be submitted for approval to the Principal. Special attention should be given in the design to prevent damage to the tank during possible surging and filling at the point of overflow at high filling rates.

To avoid damage to the tank material, it shall be ensured that all calculated elongation values are below 0.2%.

The exposed outside surfaces shall be made flame retardant to DIN 53438, class F1.

The tank shall be flexibly mounted on silent blocks. The tank manufacturer shall provide information on the approved location for the fixing points onto the body mounting frame.

2.5.3 Testing

If specified by the Principal, the tank manufacturer shall provide samples for testing. Test plates shall be taken from discs removed from the tank wall at those places where nozzles will be installed.

At least two samples shall be examined for:

Visual examination

The glass fibre reinforced laminates shall be free from following defects:

- porosity; the presence of numerous visible small craters in the laminate
- air inclusions; air entrapment within and between the layers of reinforcement, usually spherical in shape
- delamination; the separation of the layers in the laminate
- damage; scratches, cracks, indentations and delaminations caused by rough handling during manufacturing
- resin-rich and resin-starved areas.

Repairs shall not be made unless approved by the Principal.

Glass fibre reinforcement content

The glass fibre reinforcement content, determined in accordance with ASTM D2584, shall not be less than 35% by weight.

The tank shall be hydraulically tested with a 2 metre static water column for at least 30 minutes, showing no leaks or visual deformation.

2.5.4 Curing

GRE

The degree of curing shall be determined by boiling specimens in acetone (dimethyl ketone) for three hours. After boiling and drying to constant weight, the samples shall not show more than 2% loss of weight.

The degree of curing may also be assessed by determination of the transition temperature by differential scanning calorimetry (DSC) or differential thermal analysis (DTA) in accordance with ASTM D3418. The glass-transition temperature shall be at least 110 °C.

GRUP

The degree of curing shall be determined by testing the residual styrene content in accordance with DIN 16945. The residual styrene content shall not be more than 2%.

The degree of curing may also be assessed by determination of the transition temperature by differential scanning calorimetry (DCS) or differential thermal analysis (DTA) in accordance with ASTM D3418. The glass-transition temperature shall be at least 75 °C.

2.6 PAINTING AND COATING

The entire vehicle, including voids, and components (except for corrosion-resistant material), shall receive a full anti-corrosion treatment by means of a thixotropic wax-type fluid leaving an elastic, tough and water repellent film. The entire underside of the vehicle including the inside of the mud guards shall be protected.

Finishing paint shall be as follows:

- exterior of body: fire brigade red (RAL 3000)
- front and rear bumper: white (RAL 9010)
- mud guards and wheel hubs: black (RAL 9005)
- both cabin doors shall be provided with emblems and company name, layout and sign-writing details shall be supplied by the Principal
- suction and discharge water lines: olive green (RAL 9003)
- suction and discharge foam concentrate lines: yellow (RAL 1021)

- powder pipe: white (RAL 9010).

Each coat of paint shall have a dry film thickness of 40-75 µm and the total dry film thickness shall at least be 120 µm.

The battery compartment shall be coated with a chemical-resistant, 2-component epoxy paint.

The Manufacturer shall specify in his proposal the full paint procedure and the paint manufacturer.

2.7 ADDITIONAL EQUIPMENT

A selection should be made from the list given below to suit the type of vehicles required. It may also be necessary to specify other types of equipment, if required.

- 4 water suction hoses (each 3 m long), light weight with couplings . One of the hoses shall be equipped with a strainer of seawater-resistant material, and a buoyancy aid. The strainer shall have a free area of at least four times the area of the suction connection. Holes shall have a diameter not greater than 5 mm (refer MESC 96.22.70.306). A lifting eye shall be provided for the buoyancy aid.

  Hoses and couplings shall be 5 inch (125 mm) or 6 inch (150 mm).

- 4 foam suction pressure hoses, 1 $^1/_2$ inch diameter with 2 $^1/_2$ inch couplings (total hose length 10 m).

- 30 fire hoses (24 hoses 2 $^1/_2$ inch x 25 m and 6 hoses 1 $^1/_2$ inch x 25 m) all with 2 $^1/_2$ inch couplings. The hoses shall be obtained from an approved supplier (see note 1) in accordance with BS 6391 Type 3, suitable for 16 bar (ga) normal working pressure and tested at 24 bar (ga) (refer MESC 73.23.10.xxx).

  The couplings should be bronze or aluminium and the binding wire (hose/coupling) shall be of stainless steel.

- 4 pistol grip water spray/jet branch pipes, capacity 400 dm^3/min, with shut-off valve (Akron Maraunder 4626 or equivalent).

- 4 air/foam making branch pipes, water capacity 400 dm^3/min at 7 bar (ga) with inlet ball valve (Angus or equivalent).

- 2 collecting breechings with 2 $^1/_2$ inch couplings.

- 4 dividing breechings with 2 $^1/_2$ inch couplings and quick-closing outlet valves.

- 1 collecting breeching to fit into the suction coupling of the booster pump with flap valve, fitted with 2 $^1/_2$ inch couplings, caps and chains/steel wire rope.

- 6 coupling spanners to suit the couplings used.

- 6 fire extinguishers, each with 8 kg (=12 kg nominal) dry powder, urea-based potassium bicarbonate, CO_2 inside cartridge type (see note 1).

- 2 fire extinguishers of 6 kg CO_2 (see note 1).

- 2 x 30 m reeled cable and 2 tripods, for detachable flood lights (see 1.8).

- 2 stowing brackets for the detachable flood lights.

- 3 high back-pressure foam generators. The type, make and capacities shall be specified by the Principal.

- 2 wheel chocks (DIN 76051).

NOTE: 1. Supplier to indicate his preferred make/type in the quotation, for approval by the Principal.

2.8 CHEMICALS

The Manufacturer shall include the water, foam concentrate, dry chemical powder, nitrogen and fuel required for all the required tests (see section 4).

The vehicle shall be delivered empty, except for portable extinguishers and the nitrogen bottles which should be supplied completely filled.

The Manufacturer shall quote, as a separate item, for the supply of foam (normally 3% fluoroprotein supplied in drums) and for urea-based DCP.

3. OPERATING AND MAINTENANCE MANUALS

The Manufacturer shall provide 2 full sets of manuals and all relevant drawings in the English language unless otherwise specified.

The manuals shall include at least the following:

- operation and maintenance of the chassis
- operation and maintenance of the fire-fighting systems and subsystems (e.g. spark arrestors, combustion air inlet valves)
- lubrication scheme with instructions
- electrical wiring diagrams
- list of special tools
- spare parts lists of all equipment.

4. QUALITY ASSURANCE

4.1 QUALITY PLAN

The Manufacturer shall provide a quality plan with the quotation. The plan shall identify the major manufacturing steps and Principal's shop inspection involvement. The plan shall include at least the following Manufacturer's verification steps:

4.1.1 General

- Organise pre-manufacturing meeting to discuss the proposed quality plan.
- Obtain agreement of the quality plan
- Obtain agreement of the general arrangement drawings
- Obtain agreement of the fire fighting systems' main engineering documents (drawings and calculations)

4.1.2 Mechanical

Amended Per Circular 68/97

- Pressure vessels in accordance with DEP 31.22.10.32-Gen. or DEP 31.22.20.31-Gen.
- Non-metallic tanks in accordance with DEP 31.22.30.34-Gen.
- Material certification
- Material application in accordance with the approved design
- Pump and monitor casings
- Visual inspection and dimensional check of piping components (e.g. pipe schedule, flange rating and flange finish)
- Welder and welding procedure qualification.
- Pressure testing of tanks, vessels and piping systems (systems shall be without surface coating and they shall be fully accessible)
- Piping line-up and arrangements
- Relief valve settings
- Truck chassis, i.e. materials and dimensions
- Pump alignment

4.1.3 Non-mechanical

- Visual and dimensional lay-out
- Coating and Painting application
- Weather proofing
- Draining, overflow and flushing facilities
- Lighting system
- Electrical system cabling and installation
- Marking, identification and name plates
- Completeness of the vehicle and systems (incl. dimensional check)
- Additional equipment and materials
- Ergonomics (e.g. accessibility)
- Spare parts and special tools
- Operation and maintenance manuals

4.1.4 Performance testing

The following performance tests and checks shall be carried out:

4.1.4.1 Vehicle

4.1.4.1.1 Flexibility test

With a block under one front wheel and the diagonally opposite rear wheel, there should be no movement of the cab on the chassis, the lockers should function without restriction and the complete pumping system should be fully operational without additional vibration. The clearance height in the wheel guards during the (torsion) test above shall be at least 50 mm unless otherwise stated by the chassis manufacturer.

For a 2 x 2 truck the block height is 200 mm and for a 4 x 4 truck it is 250 mm.

4.1.4.1.2 Tilt test (only if specified in the requisition)

In the fully loaded condition the vehicle should be inclined at a minimum 28 degrees both to the right and to the left. During this test the chassis should not tilt more than 33 degrees. All wheels shall remain in contact with the ramp.

- Measure the wheel loading against the weight calculation
- Measure the deviation from the horizontal when fully loaded
- Brake performance test

  A brake performance test in accordance with the UN agreement, Addendum 12, Regulation 13.

4.1.4.1.3 Road test

Prior to shipping, the fully loaded vehicle should be road tested over a distance of 300 km on an average type of road. A representative of the chassis manufacturer shall attend this test.

4.1.4.1.4 Rough track test

If specified by the Principal, a 2 hour "rough track" test shall be performed. As no standardized rough track test description exists, the test shall be set up in consultation with the Manufacturer.

The test shall address the following road surfaces:

- potholed track
- cobble stone track
- (steel) washboard
- poor/repaired corrugated asphalt
- building site track
- possibly a hump track in combination with a variable obstacle track.

4.1.4.2 Superstructure

4.1.4.2.1 Hydrostatic test

The pressure-containing system shall be hydrostatically tested after the road/rough track tests (4.1.4.1.3 and 4.1.4.1.4). After this, the equipment performance tests (4.1.4.2.2, 4.1.4.2.3, 4.1.4.2.4 and 4.1.4.2.5) shall be performed.

4.1.4.2.2 Pump balance

During the shop test of pumps with anti-friction bearings, operating at rated speed or at any other speed within the specified operating range, the maximum unfiltered root mean square vibration velocity, measured on the bearing bracket in any plane, using an instrument in accordance with ISO 2954, shall not exceed the following values:

Flow range in % of flow at Best Efficiency Point (BEP)	**rms vibration velocity (mm/s)**
25 - 49	4.5
50 - 110	3

NOTE: The measured values shall serve as reference readings for future condition monitoring. Therefore these data shall be noted down in the pertaining section of the maintenance manual.

4.1.4.2.3 Full load pump test

This shall be performed for 1 hour uninterrupted to check, for example, the adequacy of the cooling system. During the test the pertaining PTO's (oil) temperature versus time shall be established by means of a contact thermometer. The obtained values serve as a reference for future checks and therefore they shall be noted in the operation and maintenance manuals (section 3).

4.1.4.2.4 Flow performance test

The following tests shall be performed to verify the performance specification. The Principal may elect to waive certain of the tests if the equipment already has "type approval".

- A vacuum of 0.6 bar (0.4 bar absolute pressure) shall be maintained for a period of at least 2 minutes.
- In by-pass mode under full flow conditions (7800 dm^3/min, maximum 10 bar (ga) inlet pressure) check for a pressure loss across the vehicle (between inlet and outlet) of typically 2 bar.
- Flow test bypassing the booster pump with hydrant pressure between 6 and 12 bar (ga) (refer 2.2.2).
- Booster pump shall be fully operational within 25 seconds after starting suction from open water with 2 lengths of suction hoses, each 3 metres, while maintaining a suction height of 3 metres from water level to centreline of pump shaft.
- In boosting mode record the required inlet pressure at a flow of 6000 dm^3/min and an outlet pressure of 12 bar (ga).
- Booster pump shall achieve a capacity of 4500 dm^3/min with hydrant pressure between 6 and 12 bar (ga) and a required discharge pressure between respectively 11 and 16 bar (ga).
- Booster pump capacity test, with suction from open water, at an equivalent suction height of approximately 3 and 6 m. To be compared with

Manufacturer's specifications (refer 2.2.2).

- Foam concentrate pump capacity test from drums into the foam concentrate tank. Foam concentrates, if behaving like Newtonian liquids, may be replaced by water (refer 2.2.5).
- Calibration of each proportioner with the pertaining foam concentrate (refer to NFPA-11C).
- Foam proportioning test (refer to 2.2.3).
- Monitor movement (refer 2.2.8)
- Water/foam monitor: capacity and throw (refer 2.2.8)
- Quality of produced foam: expansion ratio (refer 2.2.8), 25% drainage time (refer DEP 80.47.10.10-Gen.)
- Time required to pressurise the dry powder system (refer 2.3.5)
- Dry powder gun: capacity and throw (refer 2.3.6)
- Hose reels (check overrun brakes and rewind mechanism) (refer 2.3.6)
- Dry powder monitor: capacity and throw (refer 2.3.7)
- Fog guns (if ordered)
- Any other test that may be specified in the requisition.

4.1.4.2.5 Noise levels

At one metre beyond the operator panel position at the rear of the vehicle, the noise level at an elevation of +1.5 m shall not exceed 85 dB(A) under the maximum operating condition (i.e. foam proportioning in either by-pass or boosting mode).

5. SHOP INSPECTION

Shop inspection (i.e. the Principal selectively witnessing or monitoring the Manufacturer's inspection and quality control activities) should be applied, in which case the Principal shall indicate the scope of his involvement. Section 4 serves as a guide in deciding the scope of the Principal's shop inspection. The Manufacturer shall incorporate the shop inspection requirements in the quality plan.

6. PACKAGING AND SHIPPING

The equipment shall be transported in a manner which will ensure arrival at the destination in a satisfactory condition acceptable to the Principal. Shipment shall be below deck and should be by a roll-on/roll-off vessel. Exposed vehicle surfaces shall be additionally protected against a saline/marine atmosphere.

All loose and vulnerable equipment on the vehicle shall be packed in a sturdy case.

7. CHECK LIST FOR SPECIFICATION PURPOSES

This check list shall be used by the Principal to ensure that a complete specification of the type of vehicle required will be given to the Manufacturer.

1. *Type of vehicle*

- purpose: first intervention vehicle/foam concentrate carrier/twin-agent/equipment tender/other
- country of destination :
- minimum local temperature : °C
- maximum local temperature : °C
- dust area : yes/no
- driving conditions : plant roads/public roads/off-the-road/airstrip
- angle of approach : degrees
- angle of departure : degrees
- minimum clearance to road surface : mm
- maximum allowable overall (unladen) vehicle height : m
- maximum vehicle width : mm
- language to be used on identification/operating panels : English/other.

2. *Chassis*

- preferred make and type :
- climate : tropical/sub-tropical/freezing/ maximum temperature
- make and type of towing bracket : (drawbar coupling/rigid pintle hook/ball)
- type of socket for trailer brake :
- type of connection for trailer lighting : (12/24 volt):
- drive : rear wheels only/front and rear wheels
- spare wheel and tools fitted on vehicle : yes/no
- maximum permissible weights : total:
axle load:
- drive : left hand/right hand
- maximum turning circle :

3. *Engine*

   - gearbox : automatic/manual
   - on-off buzzer when vehicle is reversing
   - PTO engagement from cabin/rear operating panel
   - electric heating element in the cooling system : yes/no
   - dust filters : yes/no

4. *Cab*

   - air conditioning : yes/no
   - electric lighting system in accordance with local regulations : yes/no (if yes, state which)
   - dimensions of the mobile radio and its rack :

5. *Extended cab*

   - crew compartment : yes/no
   - construction of crew compartment : tilting cab/fastened on chassis
   - number of seats in the crew cab :
   - make and type of air breathing apparatus :
   - location and number of mounting brackets for breathing apparatus :

6. *Superstructure*

   - cabinets closed by : rollers/doors/none (open)

7. *Electrical systems*

   - battery charger : yes/no (if yes, to be supplied loose)
   - electrical supply : 110 V/220-240 V, 50/60 Hz
   - colour of revolving beacons : red/blue/yellow
   - type of cable connection for mobile radio at rear water/foam panel :

8. *Foam concentrate/water tank*

   - medium : type of foam concentrate/pre-mix, water
   - material : glass fibre reinforced epoxy/stainless steel
   - tank size : m^3

9. *Line-up of water/foam*

- discharge hose couplings : Storz/instantaneous/other
- suction hose couplings : Storz/other
- size of couplings : 2 $^1/_2$ inch/3 inch/5 inch/6 inch or 65 mm/80 mm/125 mm/150 mm
- blind caps required : yes/no
- frost protection : yes/no

10. Water/foam monitor

- required : yes/no
- remote/local control (if remote, specify frequency band)
- water capacity at 10 bar : dm^3/min.
- discharge and throw trajectories to comply with standard : NFPA/ICAO/other

11. Combined automotive and water/foam application

- required : yes/no
- duration : minutes
- maximum speed : km/hr
- maximum road inclination : degrees
- maximum required water/foam solution flow rate : dm^3/min
- maximum required water/foam solution vehicle outlet pressure : bar (ga)

NOTE: These combined requirements are not further addressed in this DEP as they are not considered necessary for the type of fire fighting vehicle normally required in the oil and chemical industry.

12. Extinguishing powder installation

- required : yes/no
- type of powder : urea-based/other
- powder monitor : yes/no
- capacity of powder monitor : kg/s
- pressurizing of powder tanks : manually/electrically/pneumatically
- number of vessels :
- capacity powder vessel : kg each
- number of hose reels :
- capacity of powder pistol : kg/s
- discharge and throw trajectories to comply with standard : NFPA/ICAO/other

13. Painting and coating

- logo and sign writing details to be supplied

14. Additional equipment

- requirements should be selected from the list (2.7) or otherwise specified

15. Initial fills of chemicals

- foam concentrate make and type :
- quantity of foam concentrate : dm^3
- dry powder make and type :
- quantity of dry powder : kg

16. Operating and maintenance manual

- language for instruction books : English/other

17. Requisition for trailer

See items 8, 9 and 14

- voltage of lighting :
- local lighting regulations :
- make and type of lighting socket :
- height of tow arrangement above ground level : m
- make and type of tow arrangement : ball/rigid pintle hook/drawbar coupling
- make and type of socket for trailer pneumatic brake system :

18. Performance testing

- road test : 300 km/1500 km/rough track (see sections 4.1.4.1.3 and 4.1.4.1.4)
- tilt test : yes/no
- noise level at operator panel position :
- other test requirements :

8. QUOTATION REQUIREMENTS

The Manufacturer shall include with the quotation the following typical equipment information:

- technical specification (including paint and undercoat)
- vehicle layout and arrangement drawing, including a top view, showing locations of tank(s), cabinets, monitor(s), hose reels, seals, pumps and inlet/outlet piping flanges
- water/foam and dry powder flow schemes
- list of all makes and types of equipment to be purchased from other suppliers. For each item the supplier's documentation or the purchasing specification shall be included
- copy of the performance curves for the type of booster pump to be supplied
- copy of the performance curves for the type of foam pump to be supplied
- performance data for the type of monitors and hand nozzles to be supplied
- test certificate for the type of proposed dry powder hose to be supplied
- list of all proposed deviations from this DEP and, where applicable, supported with reasons for the deviations
- detailed material specification/composition for all items which deviate from the specified materials
- calculations for: front and rear axle loading, centre of gravity and tilting stability
- proposed performance testing methods
- method of the proposed coding for electric wiring
- spare wheel location, if applicable
- list of recommended chassis and superstructure spare parts for two years operation (refer DEP 70.10.90.11-Gen).
- advice on chassis requirements (e.g. expected turning circle)
- costs of the chassis, include transport costs to superstructure manufacturer's works
- a quality plan (refer 4)
- proposed colour scheme
- costs for performance testing
- costs for additional copies of the operating and maintenance manuals.

9. PROPOSED TYPES OF FIRE-FIGHTING VEHICLES

The vehicles listed below are specified in sub-sections 9.1 to 9.12 and are illustrated on the standard drawings indicated.

In sub-sections 9.1 to 9.12, the cross-references to other sections relate to sub-sections in Part I of this DEP.

		Standard Drawing
Vehicle No. 1	water/foam system with booster pump, 4000 dm^3 foam concentrate tank, with monitor and 2 x 500 kg extinguishing dry powder	S 88.100
Vehicle No. 2	water/foam system with booster pump, 4000 dm^3 foam concentrate tank and 2 x 500 kg extinguishing dry powder	
Vehicle No. 3	water/foam system with booster pump, 6000 dm^3 foam concentrate tank with monitor	S 88.101
Vehicle No. 4	water/foam system with booster pump, 6000 dm^3 foam concentrate tank	
Vehicle No. 9	crew compartment, water/foam system with booster pump, 5000 dm^3 foam concentrate tank with monitor	S 88.104
Vehicle No. 10	crew compartment, water/foam system with booster pump, 5000 dm^3 foam concentrate tank	
Vehicle No. 14	water/foam system with booster pump, 3600 dm^3 water tank, 400 dm^3 concentrate tank and 2 x nominal 500 kg extinguishing dry powder	S 88.106
Vehicle No. 22	hydraulic boom vehicle	No drawing available
Vehicle No. 23	9000 dm^3 foam concentrate tank, foam concentrate transport pump	S 88.110
Vehicle No. 28	250 or 500 kg extinguishing dry powder, 250 or 500 dm^3 pre-mix foam	S 88.114
Vehicle No. 29	4000 dm^3 foam concentrate tank, inductor foam mixing system, trailer-mounted	S 88.115
Vehicle No. 30	equipment tender	S 88.116

9.1 WATER/FOAM AND DRY POWDER VEHICLE No. 1

Main items: water/foam system
4000 dm^3 foam concentrate tank
monitor
2 x 500 kg extinguishing dry powder

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- water/foam monitor (2.2.8)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- extinguishing powder unit (2.3) - (refer to flow scheme - Appendix 6)
- line-up of dry powder system (2.3.4)
- powder gun, hose and hose reels (2.3.6)
- control and operating panel, powder (2.3.8)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.2 WATER/FOAM AND DRY POWDER VEHICLE No. 2

Main items: water/foam system
4000 dm^3 foam concentrate tank
2 x 500 kg extinguishing dry powder

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- extinguishing powder unit (2.3) - (refer to flow scheme - Appendix 6)
- line-up of dry powder system (2.3.4)
- powder gun, hose and hose reels (2.3.6)
- control and operating panel, powder (2.3.8)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.3 WATER/FOAM VEHICLE No. 3

Main items: water/foam system
6000 dm^3 foam concentrate tank
monitor

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- water/foam monitor (2.2.8)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- paint work (2.6)
- additional equipment (2.7)
- testing, inspection, operating manual (2.9) (2.10)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.4 WATER/FOAM VEHICLE No. 4

Main items: water/foam system

6000 dm^3 foam concentrate tank

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.5 WATER/FOAM VEHICLE No. 9

Main items: crew compartment
water/foam system
5000 dm^3 foam concentrate tank
monitor

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab/crew compartment (1.5) (1.6)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- water/foam monitor (2.2.8)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.6 WATER/FOAM VEHICLE No. 10

Main items: crew compartment
water/foam system
5000 dm^3 foam concentrate tank

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab/crew compartment (1.5) (1.6)
- water/foam system (2.2) - (refer to flow scheme - Appendix 1)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.7 WATER/FOAM AND DRY POWDER VEHICLE No. 14

Main items: water/foam system

3600 dm^3 water tank

400 dm^3 concentrate tank

2 x 500 kg extinguishing dry powder

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- water/foam system (2.2) - (refer to flow scheme - Appendix 2)
- water booster pump (2.2.4)
- foam concentrate pump (2.2.5)
- foam concentrate tank (2.2.6 and 2.5)
- water tank (2.2.6 and 2.5)
- foam control system (2.2.3)
- line-up of water/foam system (2.2.7)
- operating and control panel, water/foam (2.2.9) - (refer to Appendix 3)
- extinguishing powder unit (2.3) - (refer to flow scheme - Appendix 6)
- line-up of dry powder system (2.3.4)
- powder gun, hose and hose reels (2.3.6)
- control and operating panel, powder (2.3.8)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.8 HYDRAULIC BOOM VEHICLE No. 22

Experience indicates that the large capital expenditure required for a fire fighting vehicle with hydraulic boom, solely based on perceived increased effectiveness, is not justifiable.

The pre-fire plans, on which such a justification should be based, often indicate that fixed fire fighting systems are the more cost effective solution. The resulting remaining risk can most often be covered by other means, e.g. stationary monitors.

In some cases the vehicle could be justified, if it is intended not only for fire fighting but also for rescue and maintenance purposes. As a result the scope of specification for this type of vehicle varies widely.

Therefore these vehicles are no longer detailed in this DEP.

9.9 FOAM CONCENTRATE TRANSPORT VEHICLE No. 23

Main items: 9000 dm^3 foam concentrate tank
foam concentrate transport pump

- chassis as described in (1.3)
- engine (1.4)
- superstructure (1.7)
- cab (1.5)
- foam concentrate system: refer to 9.9.1 and 9.9.2
- foam concentrate tank (2.2.6 and 2.5)
- foam concentrate pump (9.9.2)
- line-up of foam concentrate system (2.2.7)
- main operating and control panel (2.2.9, where applicable for foam concentrate only)
- paint work (2.6)
- additional equipment (2.7) e.g. suction and discharge hoses
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.9.1 Flow scheme

A flow scheme of the system is given in Appendix 4. The system shall have the following characteristics:

Purpose	Source of foam concentrate supply	Minimum flow rate dm^3/min	Maximum discharge pressure bar (ga)
Delivery foam liquid	direct from tank	1200	2.5
Delivery foam liquid	suction from drums, suction height 1.5 m	120	2 (at reduced r.p.m)

9.9.2 Foam concentrate pump

For conventional foam concentrates (being Newtonian liquids) a positive displacement or self priming centrifugal pump may be selected. The pump shall be driven by a PTO, see (2.2.5) and shall be able to fulfill the characteristics given above.

If the vehicle shall also cater for (future) non-Newtonian (pseudo-plastic/thixotropic) multi purpose foam concentrates, a positive displacement pump shall be applied.

The discharge pressure of the foam pump shall be adjustable by means of r.p.m. setting. The pump shall be able to transfer foam concentrate from drums or storage tank into the foam concentrate tank of the vehicle, and vice versa.

For the positive displacement pump the line-up shall be provided with a pressure relief valve, having a set pressure equal to the design pressure of the piping system and discharging into the concentrate tank. The relief valve's capacity shall be sized to handle the maximum flow with a fully blocked outlet.

To safeguard the centrifugal pump a temperature controlled valve shall be installed in the circulation line between pump discharge and foam concentrate tank.

The material of the foam pump and other details shall be as (2.2.5).

9.10 TWIN-AGENT VEHICLE No. 28

Main items: 250 or 500 kg dry chemical powder

250 or 500 dm^3 premix foam

- vehicle as described in (9.10.1)
- superstructure (9.10.2)
- flow chart - (refer to Appendix 8)
- extinguishing powder/foam unit (9.10.4)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.10.1 Vehicle

The vehicle shall be diesel or petrol-driven and be capable of transporting fire fighting systems, installed on the vehicle.

The vehicle shall be suitable for use in areas as specified; the width shall be 2.40 m max. and it shall have a single rear axle and a standard wheel base.

The driving cab (refer 1.5) shall contain seats for 3 persons and be provided with air heating or, if specified, air conditioning. The windscreen shall be of laminated tinted safety glass with sunshields. The seats shall be provided with 3-point fixing type, inertia reel seat safety belts for the outer seats and 2-point fixing for the centre seat. It shall have hydraulic power steering and two or four-wheel drive whichever is specified.

The engine shall be provided with:

- cooling capacity suitable for use in tropical areas
- synchro-mesh gearbox or automatic transmission
- exhaust pipe with spark arrestor(s) of approved type located in such a way that statutory requirements are met and the operating crew is not hindered by exhaust gases.

The vehicle shall be equipped with:

- an anti-locking brake system (ABS)
- wheels fitted with radial tyres, suitable for wet roads
- fuel tank (60 litre minimum capacity) on the inside of the chassis
- stabilizers on front and rear axle shaft (if necessary)
- mud flaps (front and rear)
- spare wheel, tools, jack shall be supplied as standard equipment and be carried on the vehicle
- battery, 12 or 24 V
- a rear towing hook capable of pulling a trailer with a minimum weight of 3500 kgf.

For use outside the refinery the specification of, for example, under-chassis clearance, under-axle differential, housing bowl clearance, minimum angle of approach and departure, and operation on a (sideways) slope needs particular attention (refer NFPA-414).

9.10.2 Superstructure

The equipment compartments, foam unit and powder unit shall be fastened to the chassis by a method which will prevent harmful influence, ensuring flexibility of the body work superstructure and good road grip for the wheels.

Electrical systems shall be in accordance with statutory regulations (refer 1.8).

The vehicle shall be equipped with the following electrical systems:

- plug and socket for battery charger, see (1.8)
- weather-protected sockets for a portable floodlight, one at each side of the driver's cabin
- lighting shall be installed so that all gauges, operating handles, storage spaces, operating panels and their surroundings are properly illuminated. This lighting shall be operable from a control switch in the driver's cabin
- a map reading-light shall be fitted on the dashboard next to the driver's seat
- a red, or other colour if specified, revolving beacon installed on top at the left and right-hand side of the driving cab
- a double-tone siren
- a red, or other colour if specified, revolving beacon at the rear of the vehicle
- one long range driving spotlight to be installed at the front of the vehicle
- fog lamps, with protectors against flying stones, fitted at the front of the vehicle, if required
- two reversing lights
- connection for trailer lighting 12 V or 24 V DC.

9.10.3 Flow chart

Extinguishing capacity	A	B
Powder	250 kg nominal	500 kg nominal
Pre-mix foam	250 dm^3	500 dm^3
Hand line(s)	1 hose reel with 25 m twinned hose	1 hose reel with 25 m twinned hose
Discharge rates (approx.):		
Powder	3.5 kg/s	3.5 kg/s
Pre-mix foam	200 dm^3/min	200 dm^3/min
Discharge range (approx.):		
Powder	12 m	12 m
Pre-mix foam	15 m	15 m
Expellent gas system	N_2 cylinder 50 dm^3/150 bar	N_2 cylinder 50 dm^3/150 bar
Powder	1	2
Pre-mix foam	1	2

9.10.4 Extinguishing powder/foam installation

The vehicle shall be equipped with the following:

- an extinguishing powder unit (for the powder system, reference is made to (2.3))	either 250 or 500 kg, see under 'A' and 'B' of the flow chart above (9.10.3)
- a premix foam unit	

To avoid accelerated degradation of the pre-mix, the pressure vessel should be non-metallic (see 2.5).

- twin high-pressure hose, minimum 25 mm diameter x 30 m long, wound on a hose reel mounted at the rear of the vehicle
- nitrogen cylinders of sufficient capacity for emptying the dry powder and foam tanks.

The hose reel shall have the least possible resistance. It shall be possible to unroll the hose under pressure without jamming. It shall be possible to operate with any length of unrolled hose. The electrically conductive twin hose shall have combined nozzles, with individual triggers for co-ordinated application by a single operator. The capacities for discharging the powder and foam shall be as given on the flow chart (9.10.3).

9.11 FOAM CONCENTRATE TRAILER VEHICLE No. 29

Main items: 4000 dm^3 foam concentrate tank

inductor foam mixing system

- water/foam system, refer to Appendix 5
- foam concentrate tank as described in (2.2.6 and 2.5)
- line-up of water/foam system (2.2.7)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.11.1 General

The trailer shall be suitable for use in areas as specified, the width shall be approximately 2.40 to 2.50 m.

Steering shall be possible by a turning the front axle with an extended towing connection.

The suspension of each axle should be designed for a reserve of at least 10% when the trailer is fully loaded.

The trailer shall be provided with pneumatic brakes for connection to the pneumatic braking system of the towing vehicle. The air pressure shall release the brakes no more than 30 seconds after the towing vehicle's engine is started. A parking brake shall be included.

Mudguards shall be provided with mudflaps.

The lighting shall be in accordance with the requirements of the local authorities, the voltage shall be 12 or 24 V as specified.

One spare wheel shall be supplied.

9.11.2 Foam control system

A manually controlled proportioning system should be applied as shown in Appendix 5. It shall be capable of varying the foam concentrate percentage between 0 and 6%. The inductors shall work effectively over the specified capacity.

The water capacity of each inductor shall be 800 dm^3/min (total capacity 1600 dm^3/min).

9.12 EQUIPMENT TENDER VEHICLE No. 30

- engine (1.4), except: power take-off for pumps, RQV regulator and enlarged cooling capacity
- chassis (1.3)
- cab (1.5)
- paint work (2.6)
- additional equipment (2.7)
- inspection and testing (4 and 5)
- operating and maintenance manual (3)

9.12.1 General

The equipment tender shall be sub-divided as desired according to the fire-fighting equipment required. The vehicle shown on the standard drawing is a typical example.

The preferred sub-division into compartments shall be indicated together with a specified list of equipment to be carried, complete with dimensions, etc.

If necessary, heavier equipment may be skid-mounted to facilitate removal from the vehicle; drawers may also be required for the storage of small items.

9.12.2 Superstructure

The equipment compartments and the total superstructure shall be fastened to the chassis beam by a method which will prevent harmful influences and ensuring flexibility of the body work superstructure. All fire-fighting equipment housed shall be stored properly, in such a way that it will not shift during driving, braking or acceleration of the vehicle.

For lighting and other requirements, see (1.3), (1.7) and (1.8).

PART II FIRE STATION

1. GENERAL

The fire station shall be built in a non-hazardous location taking into consideration the operating personnel's normal work location.

For smoke and fire detection application, see DEP 80.47.10.30-Gen.

Building requirements are covered in DEP 34.17.00.32-Gen.

1.1 LAYOUT FOR VEHICLES

The fire station shall provide parking accommodation for the required number of fire-fighting vehicles, foam trailers and movable/mobile equipment, etc. It shall be designed and located such that future extension will be possible.

The vehicles should be able to enter and leave the station parking bays at both the front and rear of the fire station. The entrances/exits shall, if required, be closed by doors, e.g. rolling shutter, counter weight, etc., designed for fast opening and constructed in such a way that the vehicles would be able to drive through them should the doors become jammed. Red and green warning lights visible from the driving seat of the vehicles shall indicate when the doors are fully closed and fully open.

If the fire station is located at a main plant road, consideration should be given to the installation of traffic lights. These lights shall be activated from the fire-fighting vehicles, so that they are in operation when vehicles are leaving the fire station.

The station shall be designed such that fire-fighting vehicles shall not have to be parked behind obstructions in the building, e.g. columns.

In locations where freezing can occur the parking areas shall be heated.

Open parking (in fire stations without doors) may be considered if climatic conditions allow, but a disadvantage will be easier entry of unauthorized persons.

Each parking bay shall be equipped with a compressed air supply for pressurizing the brakes of the vehicle, an electrical connection and cable for charging the battery and, if required, an electrical connection for the heater in the engine cooling system of the vehicle. The connections shall be made in such a way that it will be possible for the air supply to be disconnected and for plugs to be pulled out of the sockets when the vehicle drives away.

The height above the parking places, including doors, shall not be less than 5 m. A free space of 1.5 m should be available between each vehicle, between vehicle and wall and all doors. The width of each vehicle is approximately 2.5 m.

The length of a parking place should be based on the length of the longest fire fighting vehicle pulling a mobile water/foam monitor, which may be approximately 11 m in total.

1.2 WORKSHOP, OFFICE AND OTHER FACILITIES

The following facilities should be available:

- Workshop with utility connections, containing a work bench and fixed drilling and grinding machines.
- Equipment to clean, test and maintain fire hoses.
- Testing equipment for foam, dry powder and breathing air.
- Dry powder filling station.

  NOTE: Where suitable (e.g. contractor) facilities are otherwise available, some or all of the above requirements may be omitted from the building.

- Location for storing the turn out gear for the fire crew (first intervention team).
- Storage for spare parts, i.e. hoses, protective clothing, etc.
- Room for the storage of sufficient spare carbon dioxide and nitrogen bottles.

- An air compressor for breathing air should be installed in a separate room. Adequate space shall be provided for storage and first line cleaning/maintenance of self-contained breathing apparatus.
- A fire-fighting instruction room equipped with blackboard, video and overhead projector with a screen, etc., sized for about 30 people. Alternatively the training centre may be used for this purpose.
- Office accommodation for the Chief Fire Officer and his assistants.
- A slave fire alarm annunciator panel.
- Provision for the storage and loading of foam concentrate.

Hydrant(s) with a fresh water supply and facilities for the flushing out of the piping systems of the fire-fighting vehicles shall be provided near the fire station together with hose cleaning equipment.

Typical layouts of fire stations for small to medium and large-sized refineries are given in Appendices 9 and 10.

PART III

1. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

Amended Per Circular 68/97

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Index to standard drawings	DEP 00.00.06.06-Gen.
Pressure vessels (Amendments/supplements to BS 5500)	DEP 31.22.10.32-Gen.
Pressure vessels (Amendments/supplements to ASME, Section VIII, Division 1 and 2)	DEP 31.22.20.31-Gen.
Design and calculation of glass fibre reinforced epoxy vessels and equipment	DEP 31.22.30.14-Gen.
Requirements for glass fibre reinforced epoxy vessels and equipment	DEP 31.22.30.34-Gen.
Piping - general requirements	DEP 31.38.01.11-Gen.
Plant telecommunications	DEP 32.71.00.10-Gen.
Minimum requirements for design and engineering of buildings	DEP 34.17.00.32-Gen.
Spare parts for initial and normal operation	DEP 70.10.90.11-Gen.
Fire-fighting agents	DEP 80.47.10.10-Gen.
Requirements for fire protection in onshore oil and gas processing and petrochemical installations	DEP 80.47.10.30-Gen.
Portable and mobile equipment for fire-fighting	DEP 80.47.10.32-Gen.
Pre-fire planning, Typical Guidelines; Paper 204, 11/92 Fire and Technical Safety Seminar	Shell Report MF 92-1575

STANDARD DRAWINGS

NOTE: The latest edition of Standard Drawings can be found in DEP 00.00.06.06-Gen.

Fire-fighting vehicle with foam tank, foam/water system and two dry powder vessels	S 88.100
Fire-fighting vehicle with foam tank and foam/water system	S 88.101
Fire-fighting vehicle with crew compartment, foam tank and foam/water system	S 88.104
Fire-fighting vehicle with water and foam tanks, water/foam system and two dry powder vessels	S 88.106

Fire-fighting vehicle foam transport with foam/water system	S 88.110
Fire-fighting vehicle - foam/dry powder (for quick access)	S 88.114
Foam trailer with water/foam inductors	S 88.115
Equipment tender	S 88.116

AMERICAN STANDARDS

Pipe flanges and flanged fittings	ANSI B16.5

Issued by:
American National Standards Institute
1430 Broadway, New York, NY 10018
USA.

ASME Boiler and Pressure Vessel Code:	ASME IX
Qualification standard for welding and brazing procedures, welders, brazers, and welding and brazing operators	

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

Specification for seamless carbon steel pipe for high-temperature service	ASTM A 106
Specification for alloy-steel and stainless steel bolting materials for high-temperature service	ASTM A 193
Specification for carbon and alloy steel nuts for bolts for high-pressure and high-temperature service	ASTM A 194
Specification for carbon steel castings, suitable for fusion welding for high-temperature service	ASTM A 216
Specification for aluminium-bronze castings	ASTM B 148
Specification for copper-alloy condensor tube plates	ASTM B 171
Specification for copper alloy sand castings for general applications	ASTM B 584
Test method for ignition loss of cured reinforced resins	ASTM D 2584
Test method for transition temperatures of polymers by thermal analysis	ASTM D 3418

Issued by:
American Society for Testing and Materials
196 Race Street, Philadelphia
PA 19103, USA.

Mobile foam apparatus	NFPA-11C
Aircraft rescue and fire fighting vehicles	NFPA-414

Pumper fire apparatus *Issued by:* *National Fire Protection Association* *Batterymarch Park, Quincy* *MA02269, USA*	NFPA-1901

BRITISH STANDARDS

Specification for fire hose couplings and ancillary equipment	BS 336
Non-percolating lay-flat fire hoses *Issued by:* *British Standards Institution* *2 Park Street* *London W1A 2BS* *England.*	BS 6391
Area Classification Code for Petroleum Installations-Part 15 of the Institute of Petroleum Model Code of Safe Practice in the Petroleum Industry *Issued by:* *The Institute of Petroleum* *61, New Cavendish Street* *London W1M 8AR* *England*	IP-15

DUTCH STANDARDS

Brandweermaterieel Watervoerende armaturen (Fire fighting equipment Fire hose couplings and ancillary equipment) *Issued by:* *Nederlands Normalisatie Instituut* *Kalfjeslaan 2* *2600 GB Delft* *The Netherlands*	NEN 3374

GERMAN STANDARDS

Verbrennungsmotoren für allgemeine Verwendung Leistungsbegriffe, Leistungsangaben, Verbrauchangaben, Bezugszustand (Internal combustion engines for general application, definitions of rated output, rated output data, consumption data, standard operating conditions)	DIN 6271
Feuerwehrwesen, Zweipolige Steckvorrichtung 16 A 42 V (Fire-fighting equipment, two-pole connector 16 A 42 V	DIN 14690
Reaktionshärze, Reaktionsmittel und Reaktions-harzmassen; Prüfverfahren (Testing of resins, hardness and accelerators and catalyzed resins)	DIN 16945
Prüfung von brennbaren Werkstoffen Verhalten beim Beflammen mit einem Brenner. (Testing of combustible materials; reaction against a flame of a burner)	DIN 53438

Vierpolige Steckvorrichtung für 6 und 12 V Anlagen (Four-conductor connector for 6 and 12 V equipment)	DIN 72575
Unterlegkeile für Kraftfahrzeuge und Anhängefahrzeuge (Wheel chocks for motor vehicles and trailers)	DIN 76051
Druck/Saugkupplungen (Delivery/suction couplings)	DIN 143xx series

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

INTERNATIONAL STANDARDS

Classification of degrees of protectionprovided by enclosures	IEC 529

Issued by:
Central Office of the IEC
3, Rue de Varembé
CH-1211 Geneva, Switzerland.

Road vehicles - Electrical connections between towing vehicles and towed vehicles with 24 V electrical equipment - Type 24 N (normal)	ISO 1185
Road vehicles - Pneumatic braking connections between motor vehicles and towed vehicles - Interchangeability	ISO 1728
Mechanical vibration of rotating and reciprocating machinery - Requirements for instruments for measuring vibration severity	ISO 2954
Rubber products - Hoses, non-collapsible, for fire-fighting service	ISO 4642
Acoustics - Measurements of noise inside vehicles	ISO 5128
Danger signals for work places - Auditory danger signals	ISO 7731
Quality systems - Model for quality assurance in design/development, production, installation and servicing	ISO 9001
Fire-figthing vehicles and equipment. Symbols for operator controls and other displays	ISO/DIS 10085
Steel and steel products inspection documents	ISO 10474

Issued by:
ISO Central Secretariat
1, Rue de Varembé
CH-1211 Geneva, Switzerland.

Copies of international standards can also be obtained through national standards organizations.

United Nations' Agreement concerning the adoption of uniform conditions of approval and reciprocal recognition of approval for motor vehicle equipment and parts:	E/ECE/324- E/ECE/TRANS/505
Uniform provisions concerning the approval of vehicles with regard to braking	Addendum 12, Regulation 13
Safety belt anchorage	Addendum 13, Regulation 14
Safety belts	Addendum 15, Regulation 16
Strength of seats, their anchorage and head restraints	Addendum 16, Regulation 17
Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants of the cab of a commercial vehicle	Addendum 28, Regulation 29

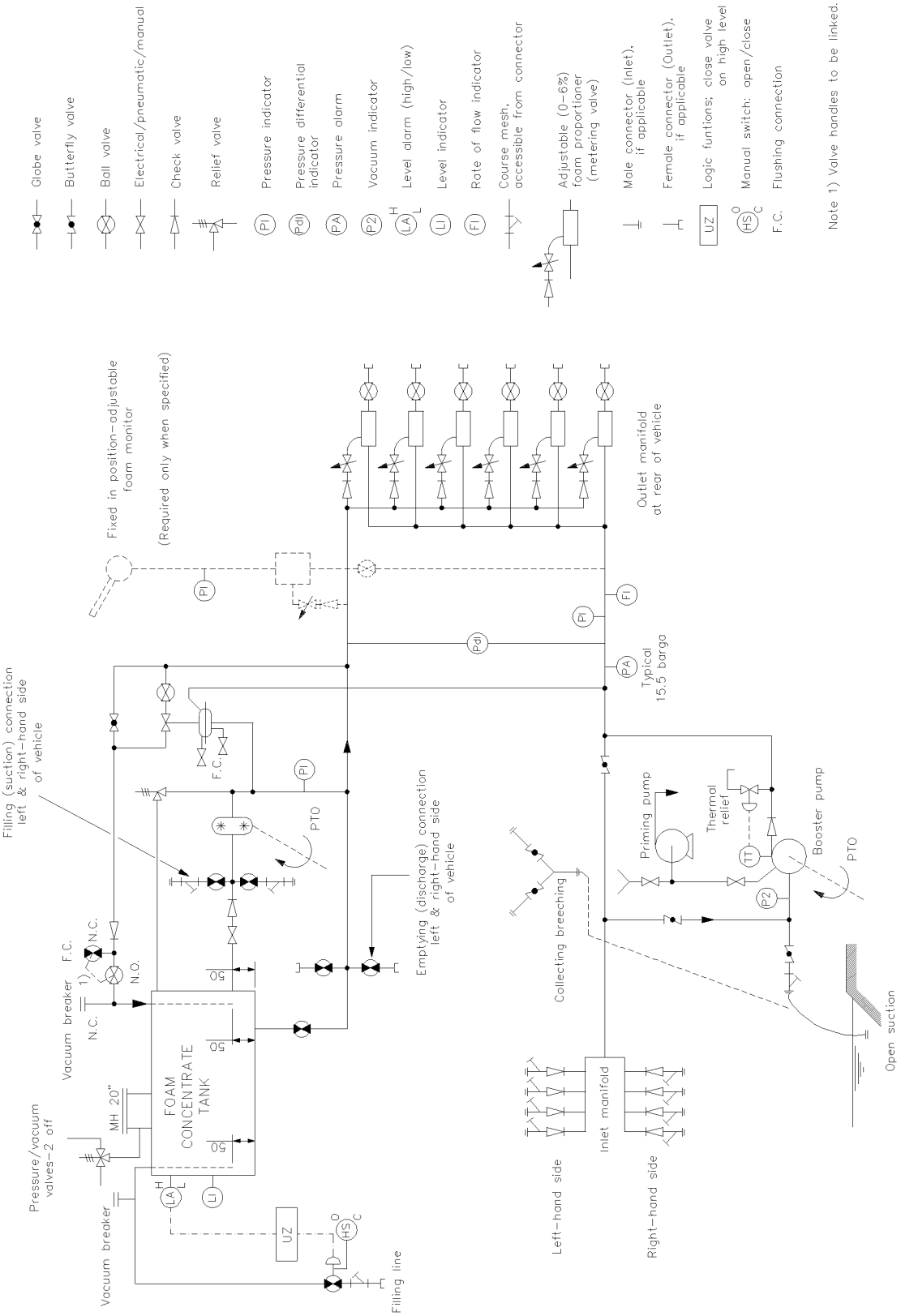
Issued by:
Nations Unies
Section de la distribution et des ventres
Palais des Nations
CH-1211 Geneva 10, Switzerland.

2. APPENDICES

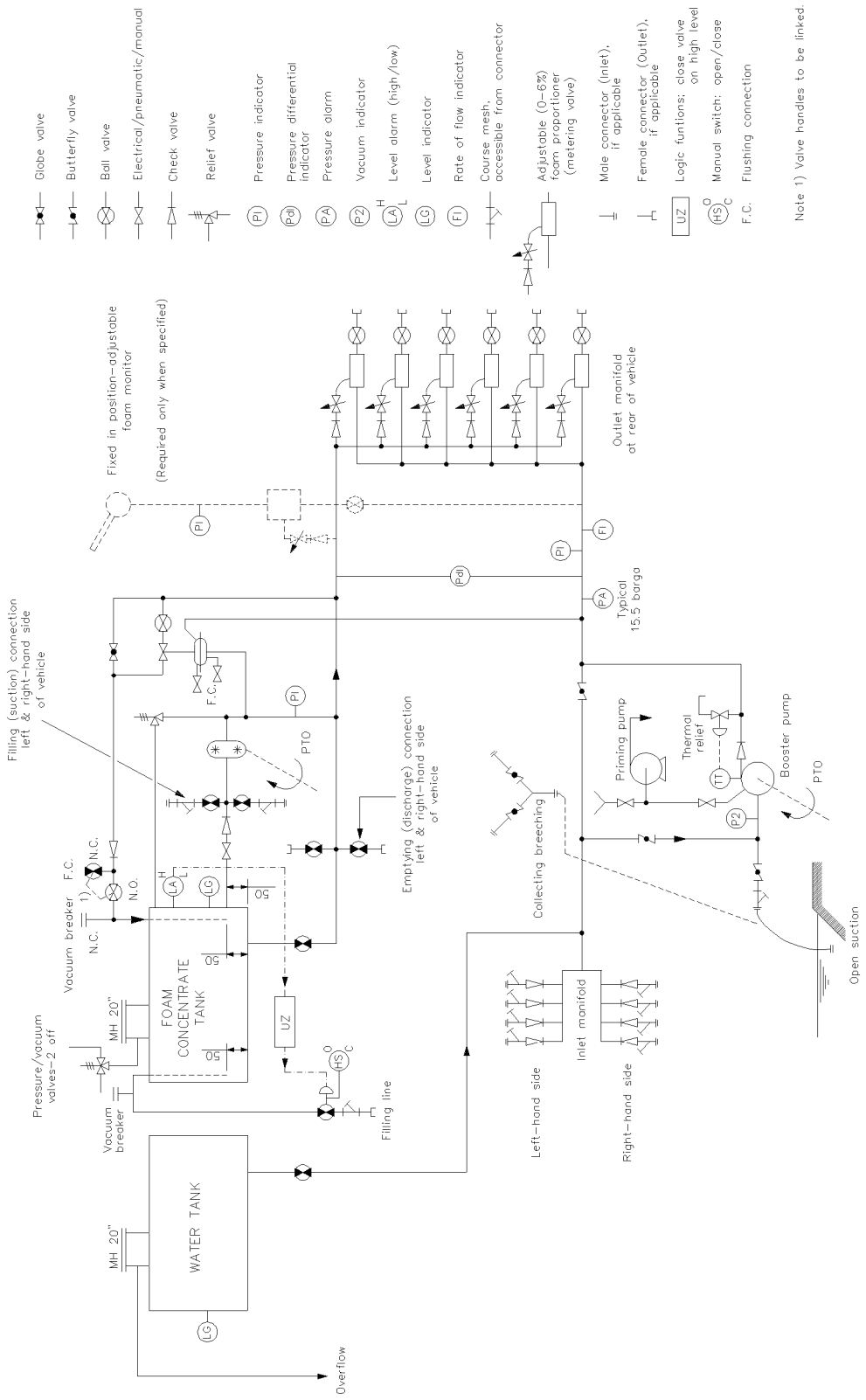
Appendix

1	Water/foam flow scheme
2	Water/foam flow scheme inclusive water tank
3	Water/foam operating panel
4	Foam concentrate flow scheme for concentrate carrier
5	Water/foam flow scheme for trailer
6	Typical dry chemical powder flow scheme for handnozzles and monitor
7	Typical membrane type level gauge
8	Pre-mix and powder flow scheme
9	Typical layout of fire station for small or medium-size refinery
10	Typical layout of fire station for large-size refinery

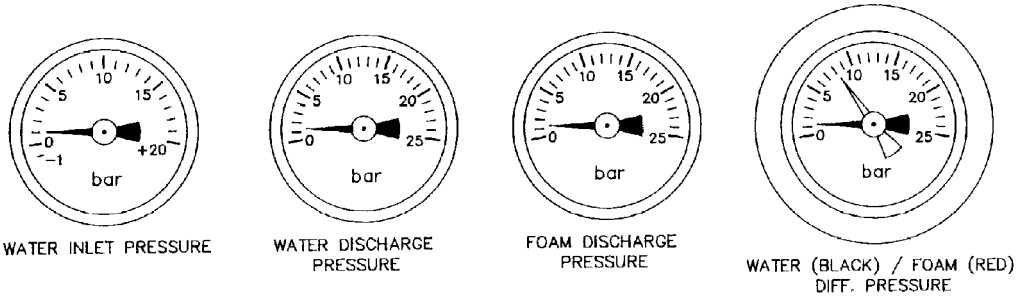
APPENDIX 1 WATER/FOAM FLOW SCHEME

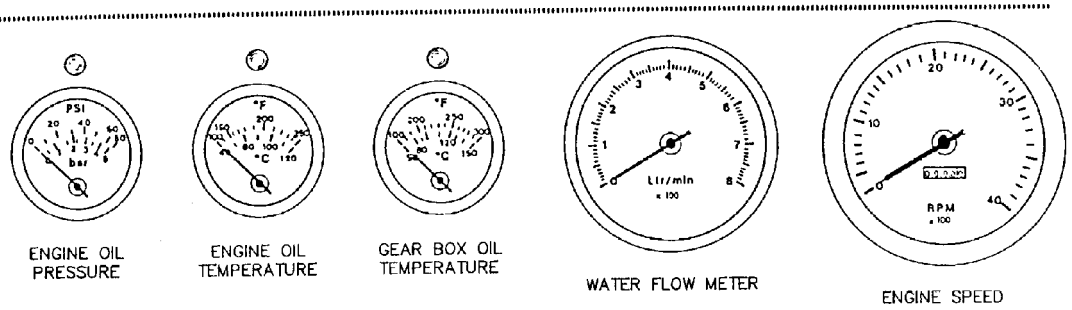


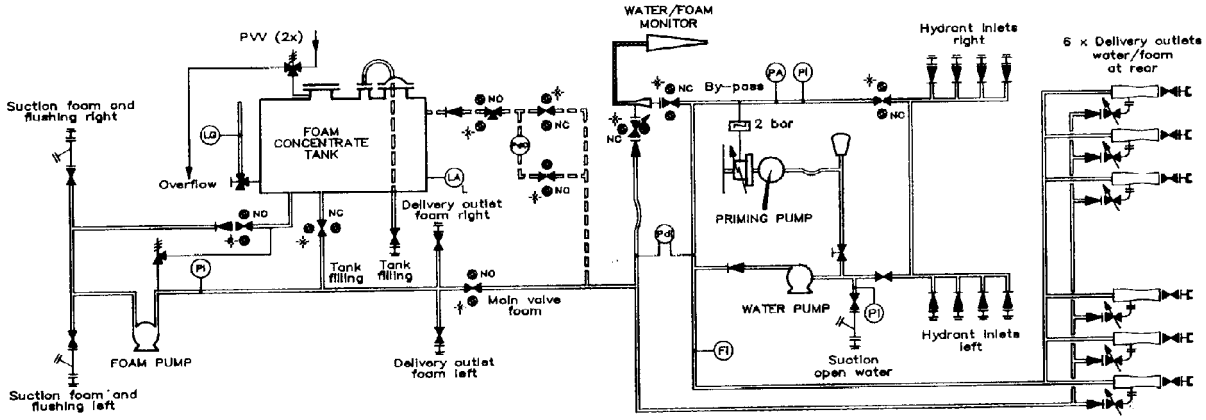
APPENDIX 2 WATER/FOAM FLOW SCHEME INCLUSIVE WATER TANK



APPENDIX 3 WATER/FOAM OPERATING PANEL







NOTES :

1. Engine throttle at the right-hand side of panel
2. Line thickness of foam/water lines is 3 mm
3. Lamps size and Colour :
   lamps in flow scheme diameter 6.4 mm
   colour orange (marked with ✳)
   colour green
   Alarming lamps diameter 11.4 mm
   colour red
   Signal lamps diameter 11.4 mm
   colour green
4. All instruments and lamps are marine waterproof
5. Colour of water/foam lines are :
   Water = olive green RAL No. 6003
   Foam = yellow RAL No. 1016

A1 WATER DISCHARGE PRESSURE – HIGH

A2 FUEL OIL LEVEL – LOW

A3 BATTERY CURRENT – LOW

A4 FOAM TANK LEVEL – LOW

ENGINE COOLING WATER TEMPERATURE – HIGH

SWITCH TO SILENCE A2 to A4

PARKING BRAKE – ON

PTO–1 ENGAGED

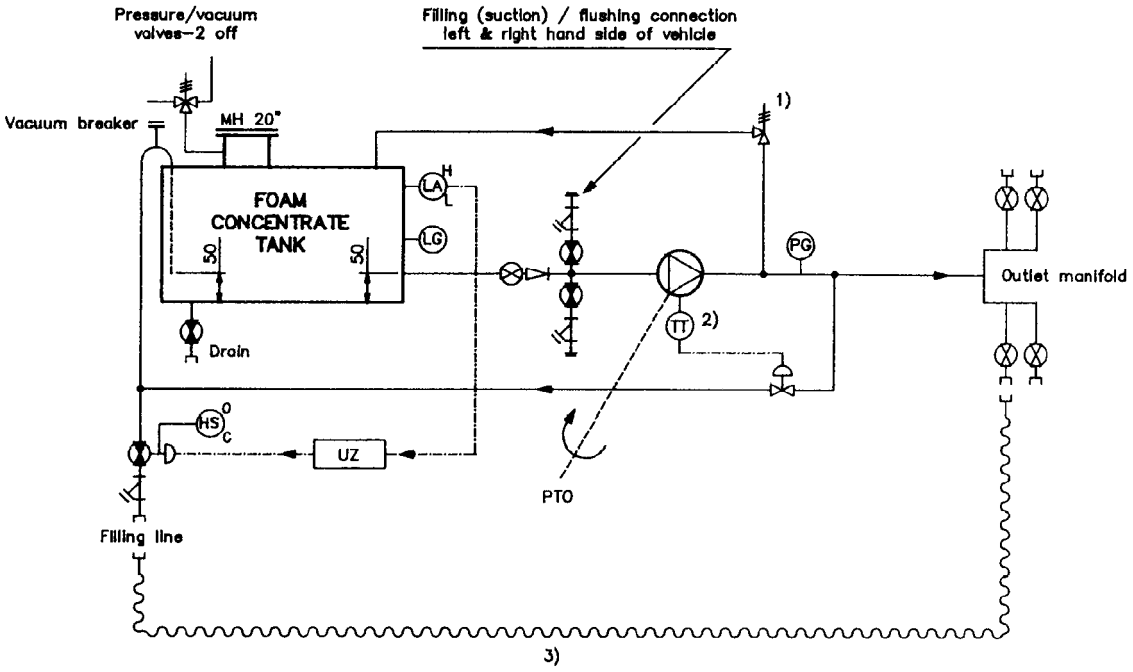
PTO–2 ENGAGED

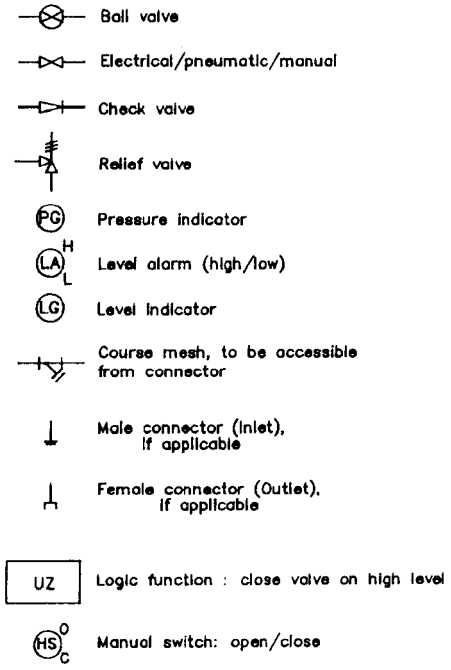
PANEL ILLUMINATION AND LAMP IND. ON/OFF

TEST LAMPS

WORKING LAMPS ON/OFF

APPENDIX 4 FOAM CONCENTRATE FLOW SCHEME FOR CONCENTRATE CARRIER

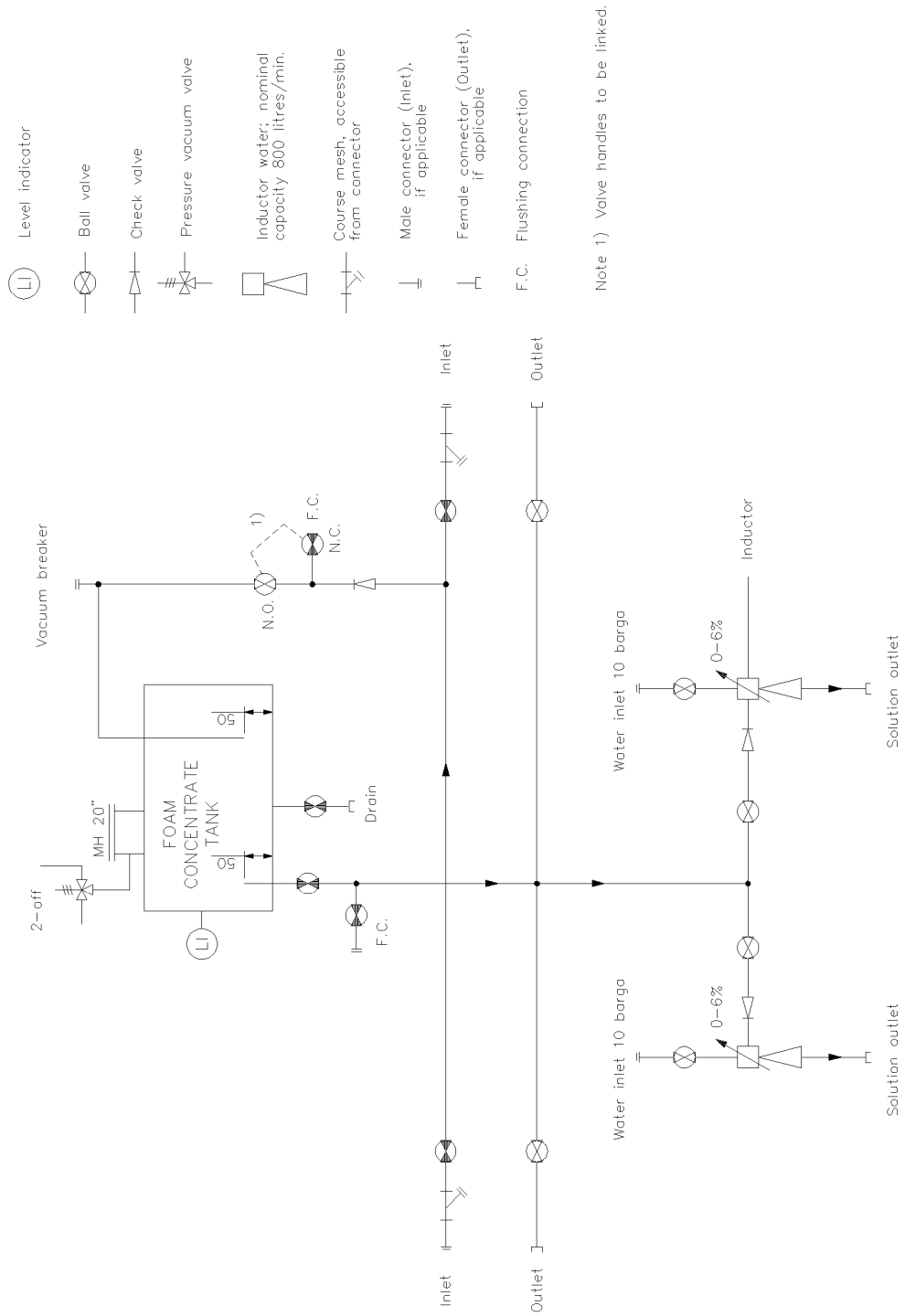




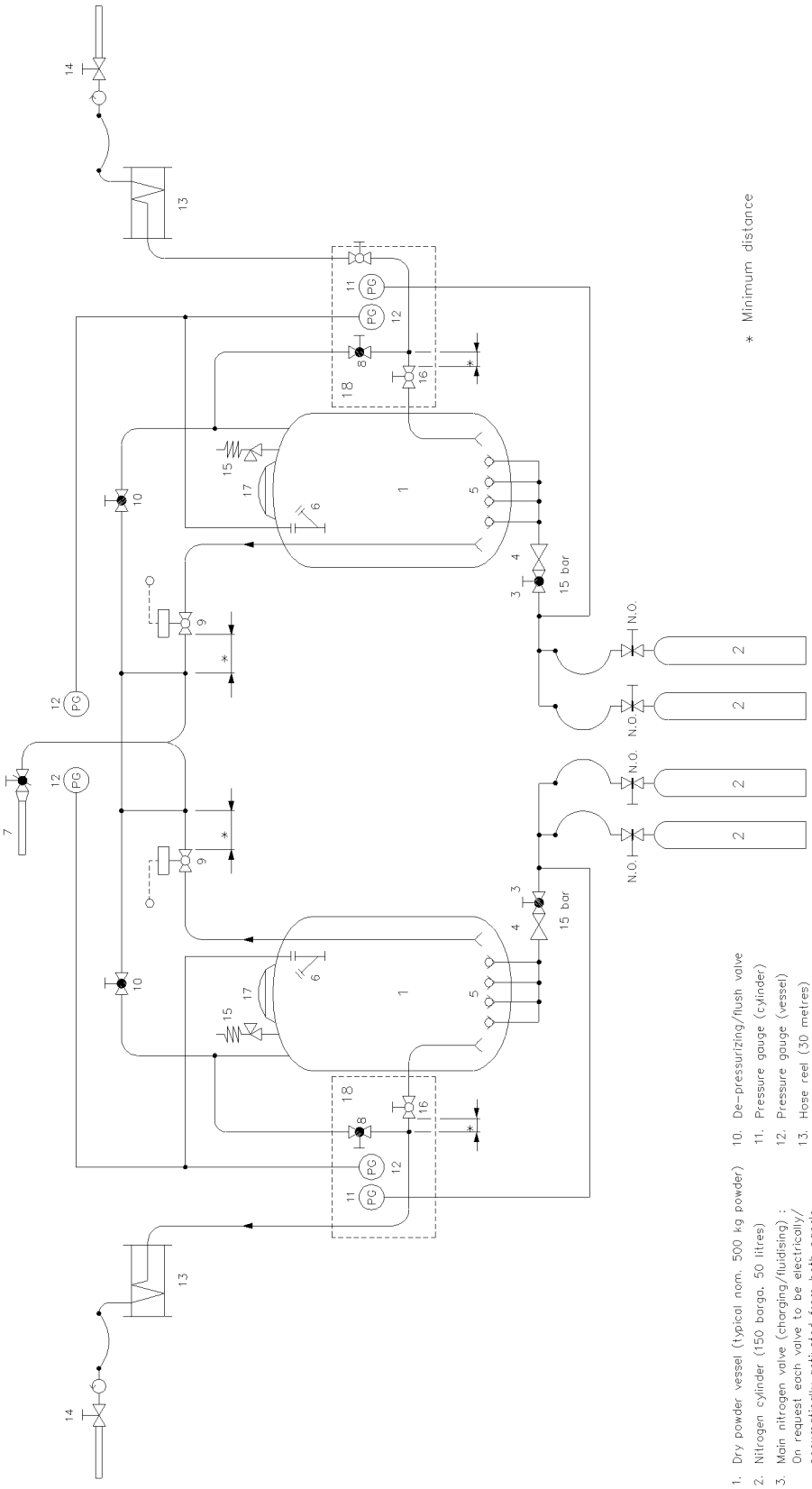
Notes :

1) Required with positive displacement pump only.
2) Required with centrifugal pump only.
3) Fire hose required to fill tank by means of carrier's own pump.

APPENDIX 5 WATER/FOAM FLOW SCHEME FOR TRAILER

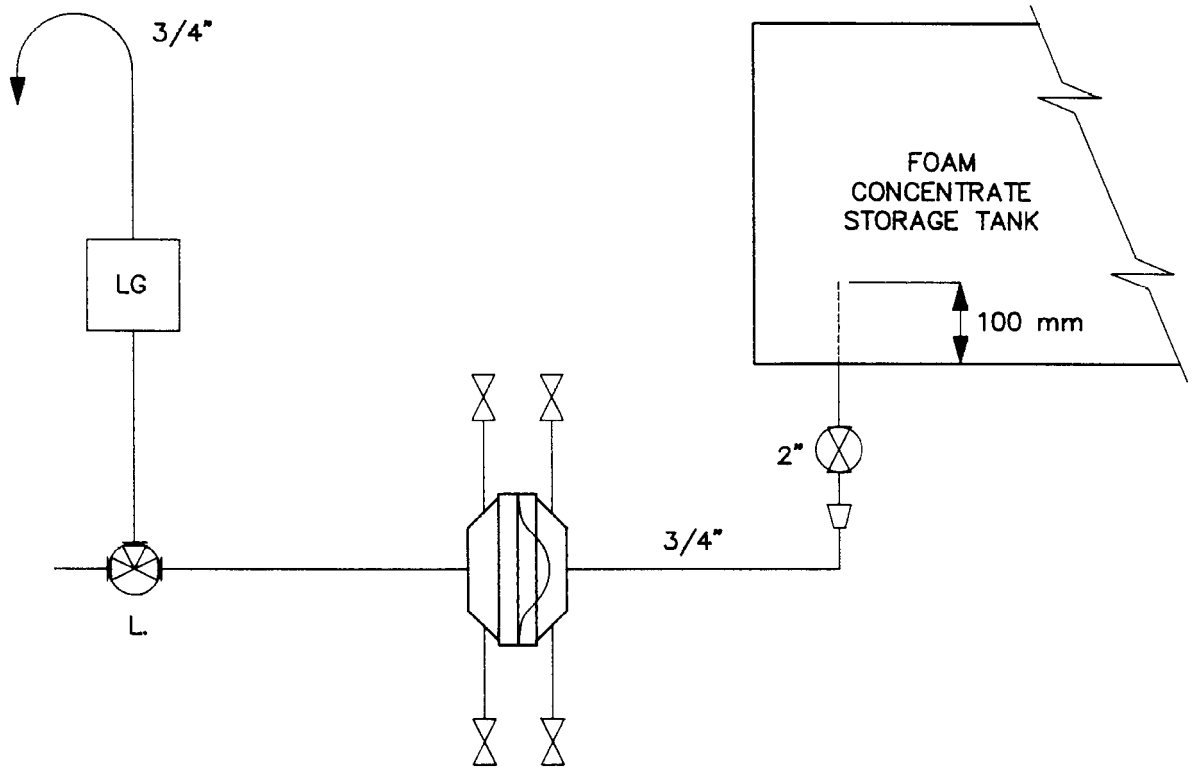


APPENDIX 6 TYPICAL DRY CHEMICAL POWDER FLOW SCHEME FOR HAND NOZZLES AND MONITOR

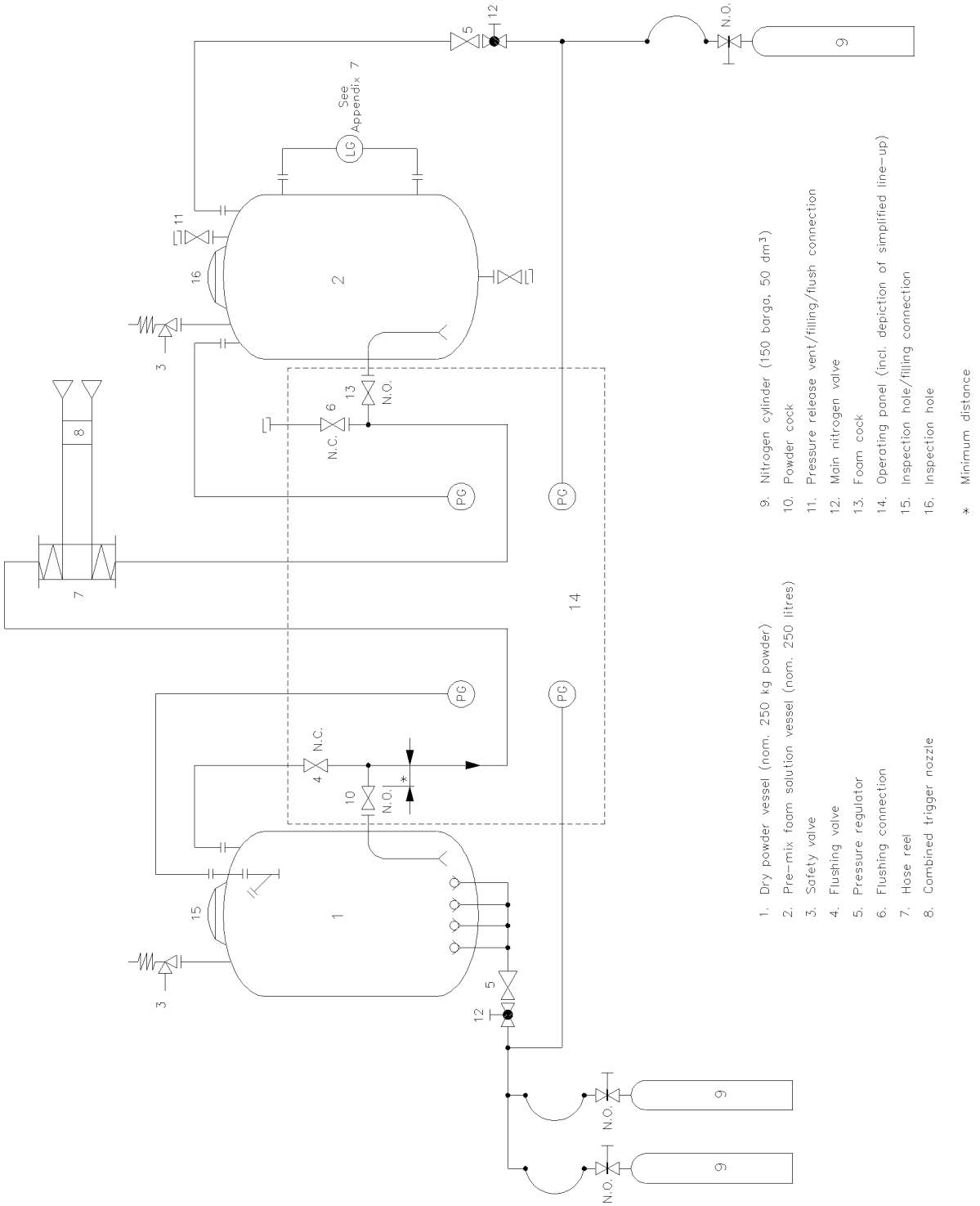


1. Dry powder vessel (typical nom. 500 kg powder)
2. Nitrogen cylinder (150 barga, 50 litres)
3. Main nitrogen valve (charging/fluidising) ; On request each valve to be electrically/ pneumatically activated from both panels
4. Pressure control regulator
5. Non-return valves
6. Filter
7. Powder monitor (20kg/sec); if specified
8. Flush valve
9. Pneumatic discharge valve
10. De-pressurizing/flush valve
11. Pressure gauge (cylinder)
12. Pressure gauge (vessel)
13. Hose reel (30 metres)
14. Powder trigger hand nozzle (2kg/sec)
15. Safety valve
16. Powder valve
17. Filling connection/inspection nozzle
18. Left/right hand side operation nozzle (incl. depiction of simplified line-up)

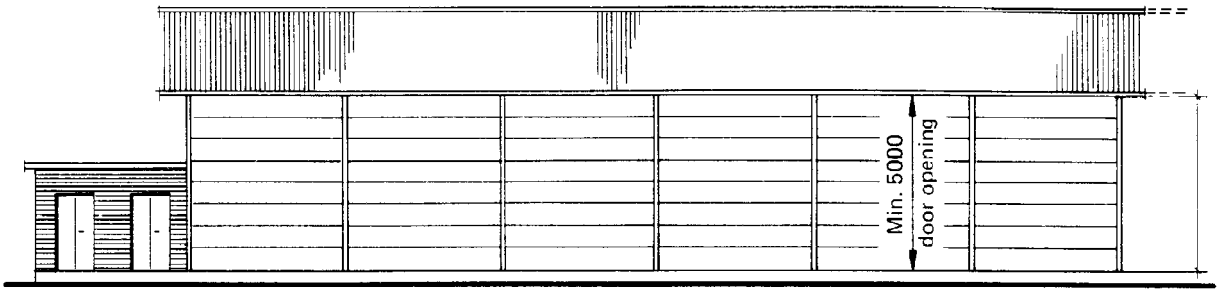
APPENDIX 7 TYPICAL MEMBRANE TYPE LEVEL GAUGE



APPENDIX 8 PRE-MIX AND POWDER FLOW SCHEME



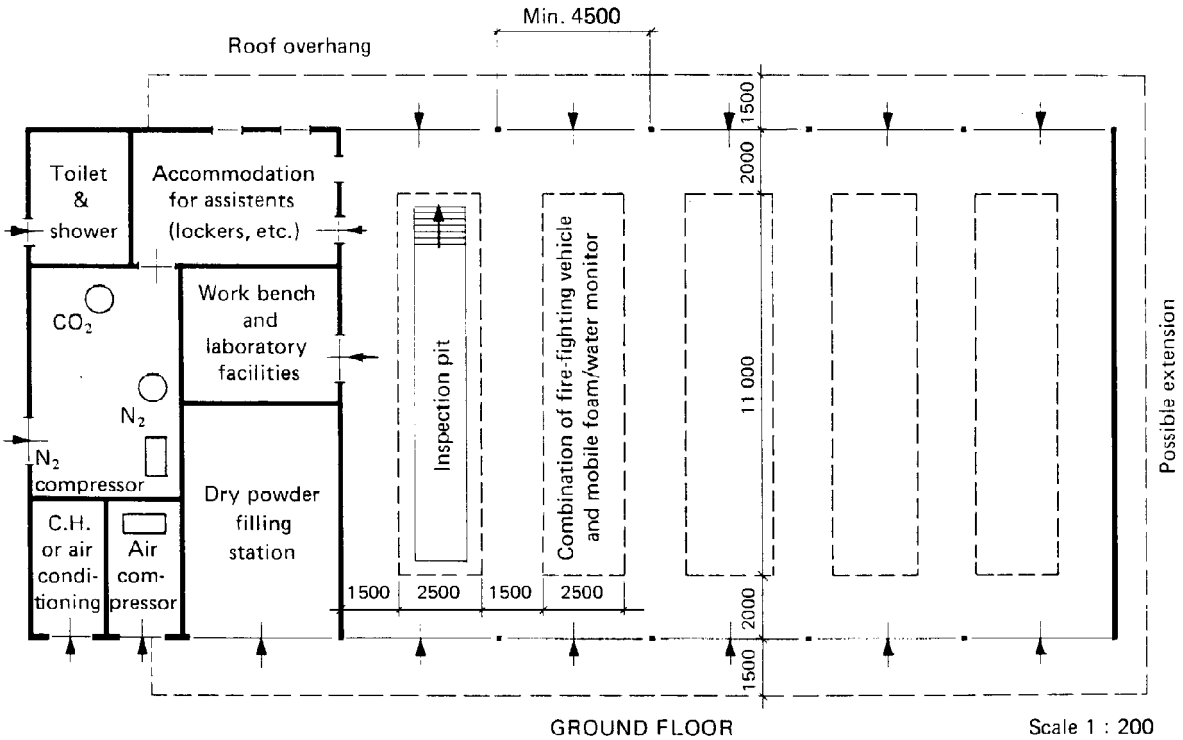
APPENDIX 9 TYPICAL LAYOUT OF FIRE STATION FOR SMALL OR MEDIUM-SIZE REFINERY



ELEVATION

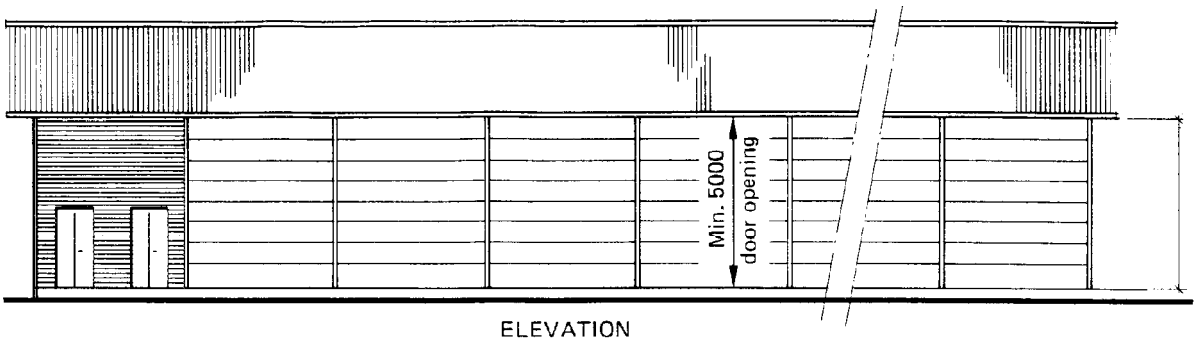
All dimensions are minimum dimensions and depend on size and number of fire-fighting vehicles and other equipment.

For small and medium-size refinery, the fire chief will be located in the main office.

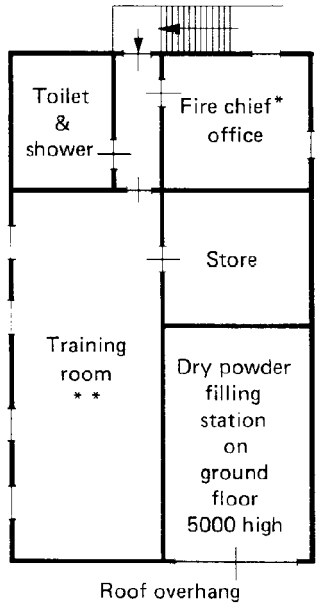


GROUND FLOOR Scale 1 : 200

APPENDIX 10 TYPICAL LAYOUT OF FIRE STATION FOR LARGE-SIZE REFINERY



ELEVATION

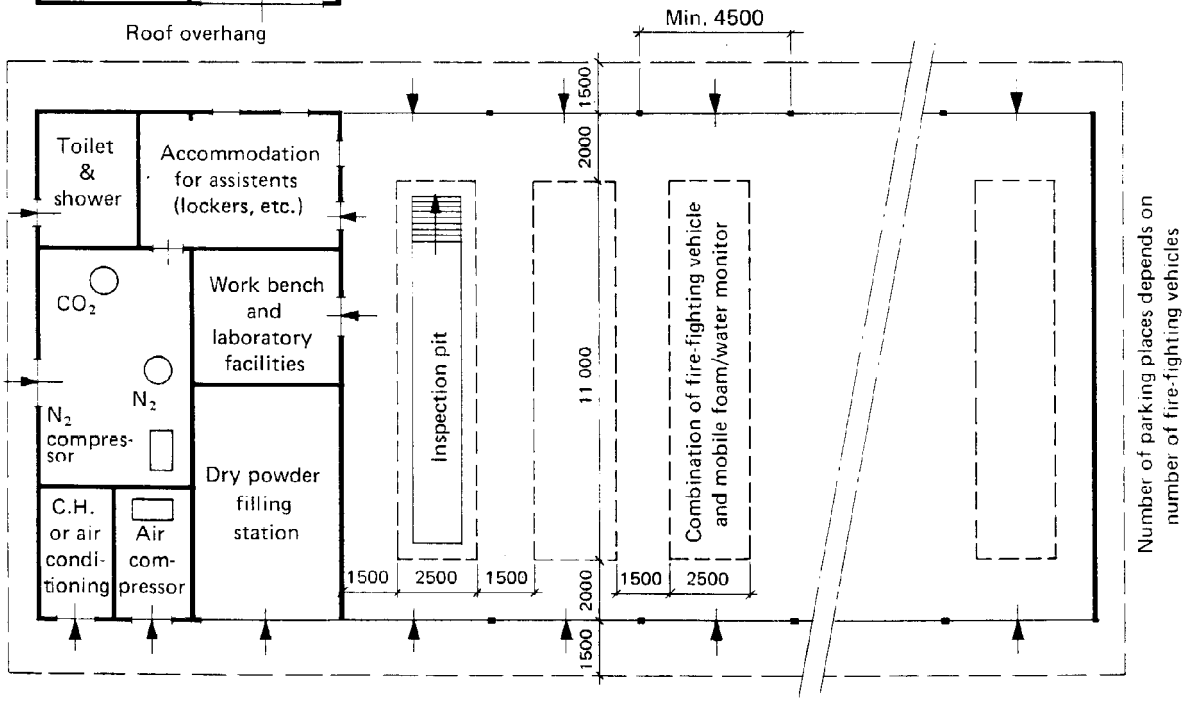


FIRST FLOOR

* Where applicable, the fire chief should reside in the fire station

** Where applicable

All dimensions are minimum dimensions and depend on size and number of fire-fighting vehicles and other equipment.



GROUND FLOOR

Scale 1 : 200