



Indian Roads Congress
Special Publication 39

**GUIDELINES ON
BULK BITUMEN
TRANSPORTATION
AND
STORAGE EQUIPMENT**

NEW DELHI 1992

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**Published by :
The Indian Roads Congress**

*Copies can be had from
The Secretary, Indian Roads Congress,
Jamnagar House, Shahjahan Road,
New Delhi-110011.*

NEW DELHI 1992

Price Rs. 120/-
(Plus packing &
postage charges)

Published in June 1992

Reprinted : September, 2002

Reprinted : June, 2011

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Printed at Aravali Printers & Publishers, New Delhi-110 020
(500 Copies)

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GUIDELINES ON BULK BITUMEN TRANSPORTATION AND STORAGE EQUIPMENT

1. INTRODUCTION

1.1. The need for conserving natural resources of petroleum and related products cannot be over-emphasised. Road construction and maintenance practices in the country also need to be upgraded to achieve this objective. Bitumen is used in large volumes and forms a substantial part of the cost of road surfacing. The present method of handling bitumen generally involves the use of non-reusable drums in which bitumen is filled and sealed at the refinery and transported to work site where they are emptied into bitumen boilers. Since one drum carries only 155 to 162 kg. of bitumen, a large number of drums require to be handled. The drums are of imported steel, which is an avoidable burden on our foreign exchange.

1.2. The method of taking out bitumen from the drum is tedious and cumbersome. Mud and dust get into the bitumen tank during loading of bitumen from the drum, thereby consuming more fuel for heating it and reducing the life of the fuel tubes and many times causing leakage of bitumen at the joint.

1.3. Thus transportation of bitumen in bulk in reusable containers of large capacity eliminates the cost of drums and in addition gives several other indirect advantages as listed below :

- (i) Saving of considerable fuel used in reheating bitumen.
- (ii) Temperature of bitumen can be accurately controlled in the required range for various applications.
- (iii) Contamination and leakage losses during transport and storage are avoided.
- (iv) Better quality control can be achieved by controlling binder usage.

1.4. In order to derive the benefits mentioned above, the Highway Construction and Mechanisation Committee (now Mechanisation Committee) in its meeting held on 24th September, 1987 had set up a Working Group consisting of S/Shri R.C. Arora, D.C. Shah, Anil Gadi and H.A. Sahazadpuri. The draft guidelines as prepared by the Working

Group were considered and approved by the Mechanisation Committee (personnel given below) in their meeting held on 23rd September, 1988.

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1.5. The Highways Specifications and Standards Committee approved the Guidelines with some modifications in their meeting held on the 30th October, 1990. The modified draft was subsequently approved by the Executive Committee in their meeting held on the 18th November, 1990. Thereafter, the draft was considered by the Council in their meeting held on the 8th December, 1990 and the Council authorised the Convenor of Highways Specifications & Standards Committee to do the necessary modifications and send to the IRC for publication. Accordingly the draft was finally modified by the Convenor, Highways Specifications and Standards Committee for printing as one of the IRC Publication.

2. SUPPLY SOURCE

2.1. Nearest refinery will naturally be the source of supply for bulk bitumen. The following possible methods can be used to deliver bulk bitumen:

- (i) Refinery to work site directly by road transport.
- (ii) Refinery to work site by combination of road and rail transport, or
- (iii) Refinery to intermediate storage depot and from storage depot to work site either by road or by rail and road.

2.2. It has been estimated that bulk bitumen transported in tankers by road is economical if the destination is upto 400 to 500 km away.

2.3. Facility for transporting bulk bitumen in rail wagons is currently available in a very limited scale in some selected pockets. For longer hauls, in times to come, more wagons may be owned by consumer or the product may move in bulk containers placed on railway flats.

3. EQUIPMENT REQUIRED

3.1. Equipment required for these operations will basically consist of the following, depending on the type of construction method, location of work site and any other local condition affecting the choice of equipment:

- (a) Transport tankers,
- (b) Storage tanks at depot,
- (c) Storage tanks at work site,
- (d) Ancilliary equipment needed for handling bulk bitumen at depot, work site and for unloading railway wagons.

3.2. A brief list of facilities required for five different anticipated situations is given in *Appendix 1* along with equipment details in brief. Depending on local conditions, to suit specific situational requirement, the exact type of equipment, capacity of the tanks, pumps etc. can be decided in consultation with the manufacturers and oil company representatives.

4. DESCRIPTION OF TANKERS

Brief description of the tankers needed for efficient and economic handling of bulk bitumen are given below :

4.1 Bitumen Transportation Tanker

Bulk bitumen is delivered by refinery into bitumen transportation tanker at a temperature of about 150° C to 170° C. At work site, bulk bitumen is transferred to site storage tanks, bitumen boilers or bitumen sprayers, so that the transportation tanker is released for the next trip.

The transportation tanker is made of mild steel sheets and should preferably be oval or elliptical in section to keep the centre of gravity low for stability. The size, weight etc., of the tank shall be determined by stipulations in the Motor Vehicles Act. Current rules permit a net load of about 10 metric tonnes. Larger capacity tanks can be mounted on trailers. The basic design features include an adequately insulated metal tank mounted on a truck platform or a trailer chassis horizontally or at a suitable inclination to facilitate gravity decantation. The insulation shall be effective to control the drop of temperature below one degree celsius per hour.

Flue tubes with burners are provided for heating bitumen to take care of any temperature drop. A dial type thermometer is provided on the tank to know the temperature of the bitumen at any point of time. On the rear of the tank is mounted a positive displacement type pump which is driven by power take-off from main engine or a separate prime mover (usually a diesel engine). The pump is used to pump out the bitumen into the storage tank. It could also be used for circulating bitumen in the tank for uniform heating.

A small foam type fire extinguisher shall be kept for emergency.

The valves shall be plug type and pipe joints preferably flanged and welded.

4.2 Stationary Storage Tanks

A set of insulated tanks of capacity 6 tonnes, 10 tonnes or 15 tonnes depending upon the requirement are to be erected at hot mix plant sites. From these tanks, the daily requirement of bitumen is to be met with. These tanks are provided with heating arrangement, pump, valves etc. It is desirable to provide heating arrangement for a set of two storage tanks. Bitumen should not be stored in empty drums at hot mix plant sites. Hot mix plant sites may be provided with storage tanks to keep stock for minimum three days requirements.

Storing bitumen in open vats is not a correct practice and should not be allowed.

The temperature of the stored bitumen should not at any time be allowed to fall so low as to make the bitumen lose its fluidity.

4.3. Mobile Storage Tank

Mobile storage tanks of 3 to 6 tonne capacity, towed type or self propelled, fitted with suitable burner and a pump, are quite useful to work with mini hot mix plants, for filling the tanks of bitumen pressure distributors, tar boilers etc. Towed type mobile storage tanks should have proper and effective towing arrangement, complying with the rules and regulations of Transport Authority.

5. GENERAL CONSIDERATIONS

5.1. The Tank

All tanks should have 10 per cent extra volume above the rated capacity. The tank which is just the receptacle for hot bitumen, can be mounted in different ways on a truck permanently; on the back of a trailer; on skids; or on a wooden platform. When the tank is permanently mounted on a truck (*Appendices 2 & 3*) it becomes essentially a transportation equipment which is temporarily immobilised at its parking site for storage purposes. Usually large tanks with a capacity of 10 to 20 MT are mounted in this manner. The smaller tanks are usually mounted in one of the remaining three ways. When it is trailer mounted, the tank acquires mobility for easy transportation from one work site to another. The skid mounting requires the tank to be provided with skid tubes as base to facilitate easy loading into a truck or unloading from it, whereas a tank mounted on a wooden platform requires the construction of a new platform at the new site. So, from the point of view of easy transportation and easy availability for work at the new site, the mountings rank as follows: truck mounting, trailer mounting, skid mounting and platform mounting. The trailer should have a rubber tyres, a turntable with 90 degree turning angle, triangular tow bar, mechanical brakes and other features required for use on public roads. It should be of all steel construction with adequate steel sections for the chassis, axles etc. and semi-elliptical springs. The skid mounting consists of tubular steel skids for the base. These skids should be of adequate

strength and welded construction. They may also be provided with towing arrangement for low speed towing for short distances at the worksite.

The platform mounting requires the construction of adequately strong platforms made of wooden sections or steel. They should be erected on firm ground and on pillars or foundation for the steel platform. It may be preferable to erect a new platform at the new worksite from a set of new members instead of dismantling the platform from the old worksite and reassembling the same at the new site. This would save time in commissioning the plant at the new site.

5.2. Constructional Features of the Tank

The tank to hold liquid bitumen shall be all-welded mild steel (M.S.) construction with fuel pipes made of seamless pipes conforming to I.S. 1239. It is recommended that the tank should be subjected to a hydrostatic pressure of 5 p.s.i. (0.35 kg per sq. m.) to detect any leak and should carry a certificate to this effect. The flue tube shall run for full length of the tank and then rise vertically upwards outside of the tank and should be provided with a suitable cowl. Cast iron (C.I.) sleeves of suitable dimensions should be fitted to the flue tube at the outer edge while fitting it in the tank for allowing the tube to expand due to heat without deforming. The valves for product outlet/discharge etc. should preferably be cast iron (C.I.) plug type, flanged and without any gland. Suitable handle shall be provided to operate the valve. The pipe line for pumping bitumen shall be of heavy duty steel with all joints welded and well insulated. The joints/coupling shall be leak proof. Provision shall be made for an outlet pipe of adequate diameter for gravity discharge with galvanized iron (G.I.) valve bottom opening duly sealed for cleaning tank in emergency.

The tank shall have a manhole of suitable size, provided with hinged cover and rapid locking device on mild steel (M.S.) collar. A non-slip platform at rear along with access ladder shall be provided. Suitable fire extinguishers shall be provided towards the rear of the tank.

A catwalk to climb to the top of tank and for safe movement of operator for inspection and measurement etc. shall be provided.

5.3. Insulation

The maximum permissible temperature drop in full load of tank shall not exceed 20°C per day when charged at 150°C with ambient temperature between 24°C and 30°C (tank and its contents at rest). Good quality insulation shall be provided for the tank to minimise heat loss during transportation and use.

All exposed parts like pipes etc. shall be properly insulated.

5.4. Pump

For pumping the product in and out of the tank, the transportation or storage tank shall be fitted with a pump. The pumps shall be driven by a separate diesel engine mounted on chassis or power take-off from main engine of truck. Pump shall be able to deliver 250 to 300 litres per minute at a pressure of about 1.8 kg/sq. cm. (25 psi). Pump shall have necessary controls for single lever type of functions like filling tank, circulation and delivery. The engine and pump shall be mounted on MS base plate and V-pulleys or directly coupled. The pump shall have a built-in bypass. The bearings and other parts of the pump shall be capable of withstanding exposure to direct heating by open flame and to transfer the bitumen having maximum temperature of 200°C.

5.5. Heating System

The tank shall have provision of suitable heating arrangement for maintaining product temperature at desired level during transportation and at the time of delivery. To boost up the product temperature as and when required, the tank shall be provided with diesel/LDO/kerosene oil etc. twin burners suitable for supplying required amount of heat for raising the temperature of rated volume from 32°C to 116°C in not more than 2 hours conforming to I.S. 2094-1962.

Separate engine provided for bitumen pump also drives a small compressor which supplies air and fuel under pressure to the burners. General arrangement in transportation tanker is indicated in pictorial view in *Appendices 2 & 3*.

It will be worthwhile to mention that latest technology for heating bitumen is by thermic fluid or by electrical heating. In case of thermic fluid, hot oil is heated separately by oil burner or electrically and the

same is circulated through pipes fitted in the compartments of bitumen tanks. Both the above systems are more efficient and economical.

5.6. Thermometer

To record product temperature, tank shall be fitted with a dial thermometer, stem type or hand held digital temperature indicator. The temperature range of the thermometer shall be 0-250°C.

5.7. Hoses and Connections

The tank shall be equipped with two flexible metallic hoses 45 cm long each with galvanized iron (G.I.) strip wound on hose made up of asbestos cord. The hoses and joints shall be leakproof and capable of withstanding product temperature of 180-200°C. It shall have non-spilling coupling in addition to positive mechanical valves.

Both the ends of each hose shall be provided with standard steel flange for fixing the hose through brass couplings and steel hexagonal nipple.

Tank connections shall be done with flexible hoses to avoid stresses induced/transferred due to piping.

5.8. Dip Rod

The tank shall have a graduated brass dip-rod, preferably square in section, to measure the contents. The dip rod shall have calibration for bitumen contents marked on both faces. Calibration of one face will indicate contents from bottom to top whereas the other face will have calibration of contents from top to bottom. Such calibration shall be both in cms and 1/2 tonne markings on each face. This will enable to find out quantity of bitumen in the tank at any time, whether the product is hot or cold. The identification number of tank/tanker shall be exhibited (engraved) on the dip-rod. The calibration chart shall be fixed at an appropriate place on the chassis or in the driver's cabin.

6. DISTRIBUTOR

Bitumen pressure distributor, where available, can also be used for transporting bitumen if the source of supply is not very far off.

7 SAFETY MEASURES

7.1. Bitumen is a hazardous material particularly when in a heated condition. All the prescribed safety standards for transportation and storage of such material shall therefore be followed. Requirements of Rules 129 to 137 of the Motor Vehicle Act, 1989 shall be complied with in respect of display of class label of the hazardous material, emergency information panel, supplying information by consigner to the owner of the vehicle and the driver regarding the material being carried etc. Every driver of a goods carriage transporting such material shall observe at all times all the precautions necessary for prevention of fire, explosion or escape of hazardous goods carried by him while goods carriage is in motion. When it is not being driven, he shall ensure that the goods carrier is parked in a place which is safe from fire, explosion or any other risk and is at all times under the control and supervision of himself or some other competent person above the age of eighteen years.

7.2. Fire fighting equipment as per statutory safety standards shall be installed wherever required.

7.3. All hot pipes shall be properly insulated and covered with appropriate leggings.

7.4. Appropriate cautionary signboards shall be displayed at all identified risky spots/places.

7.5. The crew/labourers associated with handling of bulk bitumen shall be issued with hand-gloves and gum boots etc. In the interest of their own safety it shall also be ensured that these are used by them while working.

LIST OF EQUIPMENT GENERALLY REQUIRED FOR DIFFERENT TYPES OF WORK INVOLVING USE OF BULK BITUMEN

- I. Regular and continuous use of bulk bitumen for bituminous works without the use of hot mix plant:

Equipment required :

1. Transport tanks of 10 tonne capacity with pump, diesel engine and burners.
2. Metallic hose pipe
3. Portable storage tanks at site
4 tanks of 3 tonne each or
3 tanks of 4 tonne each
4. Four kerosene burners with one fuel tank and air pump for each storage tank.

- II. Isolated surface dressing type of works within 400 kms from refinery :

Equipment required :

1. Transport tanks of 10 tonne capacity with pump, diesel engine and burners
2. Metallic hose pipe
3. Optional :
Three tonne capacity portable storage tanks or bitumen boilers at work site with kerosene burners and kerosene tank. Storage tanks at site will be necessary when the transport tank has to be released immediately either to supply part load at other location or for the next trip to the refinery.

- III. Works using normal bitumen mixer or smaller works using upto 5 tonne of bitumen per day :

Equipment required :

Same as in situation II above.

- IV. Hot mix plants or mixer units having an output of 20 tonnes per hour and more:

Equipment required :

1. Transport tanks with burners and hose pipe. Pump and engine are not necessary.
2. At work site - minimum two storage tanks - one tank of 10 tonne capacity and one of 6 tonne capacity
or
Two tanks of 6 tonne capacity.
3. Gear pump with an output of 500 litres per minute at 500 rpm.
4. Diesel engine - 5 HP or
Electric motor - 5 HP

5. Low pressure burners using light diesel oil or furnace oil for storage tanks.
Two for each tank
6. Air blower for burners. This can be driven by the same motor or diesel engine used for gear pump.
7. Portable kerosene burners with kerosene tank and air pump.
8. Metallic hose pipe

V. For Locations requiring a central supply depot:

A. Facilities to feed the depot -

1. Transport tanks in adequate numbers-pump and engine is not required on the tank

or

Railway tank wagons for bulk bitumen transport.

B. Facilities at the depot :

1. Portable unit for decanting a railway tank wagon consisting of -

Low pressure burners.

Blower for burner.

Gear pump with diesel engine.

Hose pipe long enough to transfer bitumen from tank wagon to transport tank.

Portable kerosene burner with fuel tank.

2. Bulk bitumen storage tanks :
Two tanks of 20 tonne each

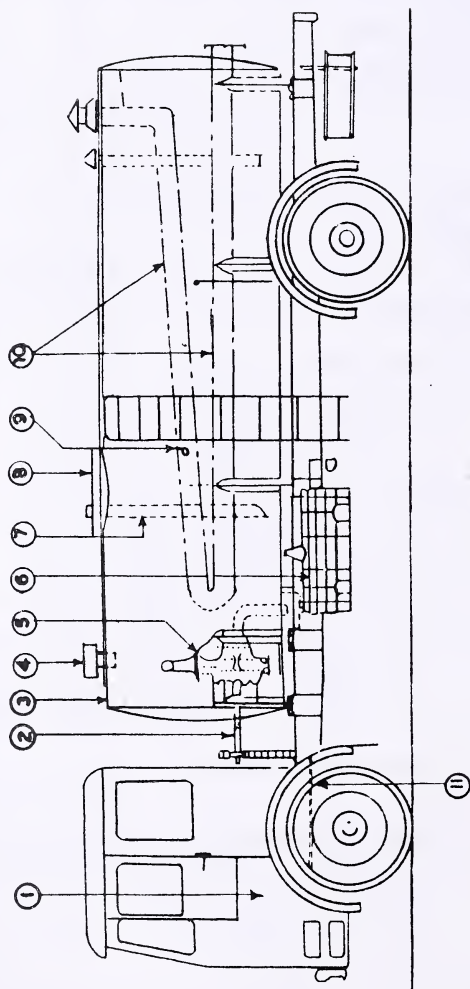
or

One tank of 20 tonne and one of 10 tonne.

3. Gear pump with output of 400 to 500 litres per minute at 500 rpm approximately.
Electric motor of 5 HP capacity.
4. Low pressure burners working on Light Diesel Oil with air blower and electric motor.
5. Portable kerosene burners with fuel tank.
6. Metallic hose pipes.

C. Facilities required for transporting bulk bitumen from depot to work site and for use at work site will be according to any one of four mentioned in Sections I, II, III or IV.

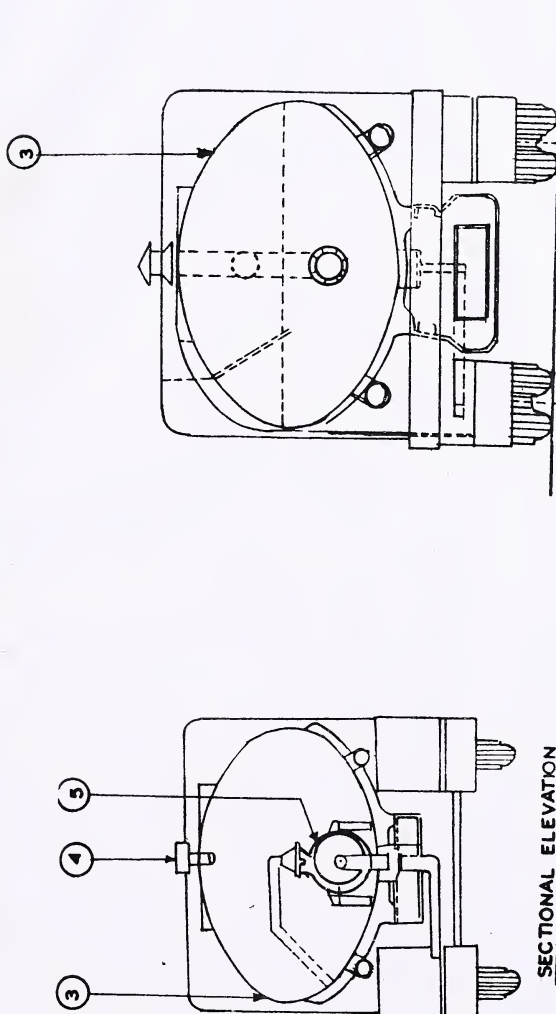
Bitumen Transportation Tank General Construction



ELEVATION

- | | |
|-------------------------|------------------------------------|
| 1. ENGINE | 7. TANK CONTENT GAUGE |
| 2. POWER TAKE OFF SHAFT | 8. MANHOLE COVER |
| 3. TANK | 9. THERMOMETER |
| 4. PRESSURE VENT | 10. FLUE PIPE |
| | 11. PASSENGER TAKE OFF ARRANGEMENT |

Bitumen Transportation Tank General Construction



END VIEW

3. TANK

3. TANK

4. PRESSURE VENT.

5. PUMP

