Chapter 17

TERMINAL SYSTEMS AND EQUIPMENT

This Chapter describes equipment that is provided by the terminal at the tanker/shore interface, including fendering, lifting, lighting and bonding and earthing equipment.

Considerable emphasis is placed on ensuring that the tanker and shore remain electrically isolated, and on the means of achieving isolation.

17.1 Electrical Equipment

The classification of hazardous zones for the installation or use of electrical equipment within a terminal is described in Section 4.4.2.

Terminals should ensure that any electrical equipment is provided in accordance with a site specific area electrical classification drawing, which shows hazardous zones at the berths in plan and elevation.

Terminals should identify the zones and establish the type of equipment that is to be installed within each zone. National legislation, international standards and company specific guidelines, where available, are all to be complied with. A planned maintenance system should address the continued integrity of the equipment installed, and ensure it remains able to meet zone requirements.

Personnel carrying out maintenance on equipment within hazardous zones should be trained and certified as competent to carry out the work. Certification may be by internal process or as required by regulatory bodies. All electrical maintenance should be carried out under the control of a Permit to Work system (see Section 19.1.3).

17.2 Fendering

Fendering systems at each berth should be engineered to suit the range of tanker sizes and types that use the berth and should be capable of withstanding expected loads without causing damage to the tanker. The design should take account of the method of operating the berth.

In calculating the berthing energy to be absorbed by the fendering system, the speed at which a tanker closes with the berth is the most significant of all factors. Energy is calculated as a function of mass and the square of the speed ($E = ½mv^2$). (See Section 15.6.2.)

The spacing of the fenders should allow the tanker to lie alongside, with the fenders on the parallel sides of the tanker, at all freeboards and all expected heights of the tide.

The terminal should advise tanker captains and berth operating personnel of the maximum permissible closing speed for each berth, recognising that this is often difficult to estimate.

17.3 Lifting Equipment

17.3.1 Inspection and Maintenance

All equipment used for the lifting of cargo transfer equipment and/or means of access should be examined at intervals not exceeding one year and load tested at intervals not exceeding five years, or more frequently if mandated by local regulation or Company requirements.

Equipment to be tested and examined includes:

- Cargo hose handling cranes, derricks, davits and gantries.
- Gangways and associated cranes and davits.
- Cargo loading arm cranes.
- Store cranes and davits.
- Slings, lifting chains, delta plates, pad eyes and shackles.
- Chain blocks, hand winches and similar mechanical devices.
- Personnel lifts and hoists.

Tests should be carried out by a suitably qualified individual or authority and the equipment should be clearly marked with its Safe Working Load (SWL), identification number and test date.

Terminals should ensure that all maintenance is carried out in accordance with manufacturers' guidelines and that it is incorporated into the terminal's planned maintenance system.

If certified equipment is modified or repaired, it should be re-tested and certified prior to being placed back in service.

Defective equipment should be withdrawn from service immediately and only reinstated after repair, examination and, where required, re-certification.

17.3.2 Training in the Use of Lifting Equipment

All personnel engaged in operating lifting equipment should be formally trained in its use.

17.4 Lighting

Terminals should have a level of lighting sufficient to ensure that all tanker/shore interface activities can be safely conducted during periods of darkness.

Lighting levels should meet national or international engineering standards as a minimum. Particular consideration should be given to lighting of the following areas:

- Berth or jetty-head working areas.
- Access routes.
- Berth or jetty perimeters.
- Boat landings.
- Mooring dolphins and walkways.
- Stairways to elevated gantries.
- Emergency escape routes.
- Lighting of water around berth to detect spillage and possibly unauthorised craft.

17.5 Tanker/Shore Electrical Isolation

17.5.1 General

Due to possible differences in electrical potential between the tanker and the berth, there is a risk of electrical arcing at the manifold during connection and disconnection of the shore hose or loading arm. To protect against this risk, there should be a means of electrical isolation at the tanker/shore interface. This should be provided by the terminal.

It should be noted that the subject of tanker-to-shore electric currents is quite separate from static electricity, which is discussed in Chapter 3.

17.5.2 Tanker-to-Shore Electric Currents

Large currents can flow in electrically conducting pipework and flexible hose systems between the tanker and shore. The sources of these currents are:

- Cathodic protection of the jetty or the hull of the tanker provided by either an impressed current system (Impressed Current Cathodic Protection - ICCP) or by sacrificial anodes.
- Stray currents arising from galvanic potential differences between tanker and shore or leakage effects from electrical power sources.

An all metal loading or discharge arm provides a very low resistance connection between tanker and shore and there is a very real danger of an incendive arc when the ensuing large current is suddenly interrupted during the connection or disconnection of the arm at the tanker manifold.

Similar arcs can occur with flexible hose strings containing metallic connections between the flanges of each length of hose.

To prevent electrical flow between a tanker and a berth during connection or disconnection of the shore hose or loading arm, the terminal operator should ensure that cargo hose strings and metal arms are fitted with an insulating flange. An alternative solution with flexible hose strings is to include, in each string, one length only of non-conducting hose without internal bonding. The insertion of such a resistance completely blocks the flow of stray current through the loading arm or the hose string. At the same time, the whole system remains earthed, either to the tanker or to the shore.

All metal on the seaward side of the insulating section should be electrically continuous to the tanker; all metal on the landward side should be electrically continuous to the jetty earthing system. This arrangement will ensure electrical discontinuity between the tanker and shore, and prevent arcing during connection and disconnection.

The insulating flange or single length of non-conducting hose must not be short circuited by contact with external metal. For example, an exposed metallic flange on the seaward side of the insulating flange or hose length should not make contact with the jetty structure, either directly or through hose handling equipment.

It should be noted that the requirements for the use of insulating flanges or an electrically discontinuous length of hose also apply to the vapour recovery connection.

In the past, it was usual to connect the tanker and shore systems by a bonding wire via a flameproof switch before the cargo connection was made and to maintain this bonding wire in position until after the cargo connection was broken. The use of this bonding wire had no relevance to electrostatic charging. It was an attempt to short circuit the tanker/shore electrolytic/cathodic protection systems and to reduce the tanker/shore voltage to such an extent that currents in hoses or in metal arms would be negligible. However, because of the large current availability and the difficulty of achieving a sufficiently small electrical resistance in the tanker/shore bonding wire, this method has been found to be quite ineffective for its intended purposes but has itself created a possible hazard to safety. The use of tanker/shore bonding wires is therefore not recommended. (See Section 17.5.4.)

While some national and local regulations still require mandatory connection of a bonding cable, it should be noted that the IMO ‘Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas’ (1995) urge port authorities to discourage the use of tanker/shore bonding cables and to adopt the recommendation concerning the use of an insulating flange (see Section 17.5.5. below) or a single length of non-conducting hose as described above. Insulating flanges should be designed to avoid accidental short circuiting.

Current flow can also occur through any other electrically conducting path between tanker and shore, for example mooring wires or a metallic ladder or gangway. These connections may be insulated to avoid draining the jetty cathodic protection system by the added load of the tanker’s hull. However, it is extremely unlikely that a flammable atmosphere would be present at these locations while electrical contact is made or interrupted.

Switching off cathodic protection systems of the impressed current type (required in some national and local regulations) either ashore or on the tanker, is not in general considered to be a feasible method of minimising tanker/shore currents in the absence of an insulating flange or hose. A jetty which is handling a succession of tankers would need to have this cathodic protection switched off almost continuously and would therefore lose its corrosion resistance. Further, if the jetty system remains switched on, it is probable that the difference of potential between tanker and shore will be less if the tanker also keeps its cathodic protection system energised. In any case, the polarisation in an impressed current system takes many hours to decay after the system has been switched off, so the tanker would have to be deprived of full protection, not only while alongside but also for a period before arrival in port.

17.5.3 N/A

17.5.4 Tanker/Shore Bonding Cables

A tanker/shore bonding cable does not replace the requirement for an insulating flange or hose as described above. Use of tanker/shore bonding cable may be dangerous and should not be used.

Although the potential dangers of using a tanker/shore bonding cable are widely recognised, attention is drawn to the fact that some national and local regulations may still require a bonding cable to be connected.

If a bonding cable is insisted upon, it should first be inspected to see that it is mechanically and electrically sound. The connection point for the cable should be well clear of the manifold area. There should always be a switch on the jetty in series with the bonding cable and of a type suitable for use in a Zone 1 hazardous area. It is important to ensure that the switch is always in the ‘off’ position before connecting or disconnecting the cable.

Only when the cable is properly fixed and in good contact with the tanker should the switch be closed. The cable should be attached before the cargo hoses are connected and removed only after the hoses have been disconnected.

17.5.5 Insulating Flange

17.5.5.1 Precautions

See Figure 17.1 for a schematic diagram of a typical insulating flange joint.

Points to be borne in mind when fitting an insulating flange are:

- When the tanker-to-shore connection is wholly flexible, as with a hose, the insulating flange should be inserted at the jetty end where it is not likely to be disturbed. Then the hose must always be suspended to ensure the hose-to-hose connection flanges do not rest on the jetty deck or other structure that may render the insulating flange ineffective.
- When the connection is partly flexible and partly metal arm, the insulating flange should be connected to the metal arm.
- For all metal arms, care should be taken to ensure that, wherever it is convenient to fit the flange, it is not short circuited by guy wires.
- The location of the insulating flange should be clearly labelled.

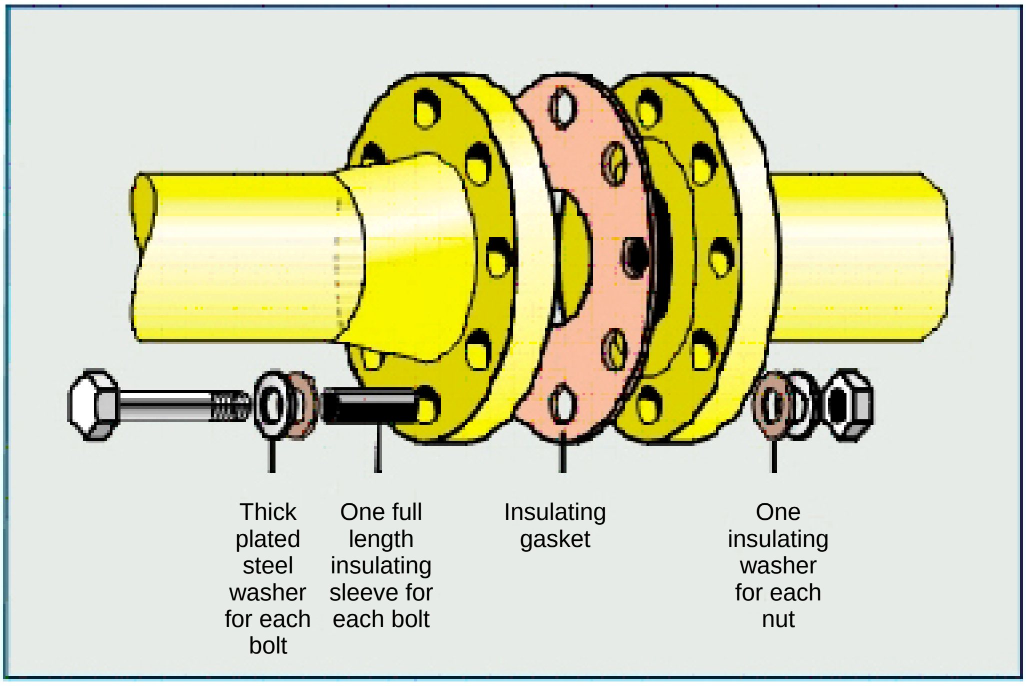

Figure 17.1 - Schematic diagram of insulating flange

17.5.5.2 Testing of Insulating Flanges

Insulating flanges should be inspected and tested at least annually, or more frequently if considered necessary. Factors to be taken into consideration when determining testing frequency should include risk of deterioration due to environmental exposure, usage, and damage from handling. It should be ensured that the insulation is clean, unpainted and in an effective condition. Readings should be taken between the metal pipe on the shore side of the flange and the end of the hose or metal arm when freely suspended. The measured value after installation should be not less than 1,000 ohms. A lower resistance may indicate damage to, or deterioration of, the insulation. The terminal should maintain records of all tests on all the insulating flanges within the terminal.

An insulating flange is designed to prevent arcing caused by low voltage but high current circuits (usually below 1 volt, but potentially up to around 5 volts and with currents rising to possibly several hundreds of amps) that exist between tanker and shore due to stray currents, cathodic protection and galvanic cells. It is not intended to give protection against the high voltage but low current sparks associated with static discharge.

Therefore, even if the resistance of the flange drops below the 1,000 ohms quoted above due, for example, to ice, salt spray or product residue, any current flow will still be limited to a few milliamps as the potential difference across the flange will be far less than is required to initiate an arc during connection or disconnection of loading arms or hoses. Conversely, trying to earth (ground) a low voltage/high current circuit with a bonding cable is difficult, even if a very low resistance cable is used. The total resistances of the cable circuit connections and any switching device, combined with the availability of a very large current, will effectively prevent the potential difference between the tanker(s) and shore becoming zero and will render this circuit ineffective as a means of eliminating - tanker/shore and tanker/tanker currents in loading arms and hoses.

Typical DC insulation testers are often arranged with a user selectable test voltage (500/250/50 V etc) but are not normally accurately ranged or capable of adequately applying voltages to resistances as low as 1,000 ohms. These instruments are therefore not best suited for routine testing, but could be used for new installations where there will be no contamination of the flange and insulation readings will be many times higher. Routine testing should therefore be undertaken with an insulation tester specifically designed to have a typical driving voltage of 5 V or more when applied to a resistance of 1,000 ohms or greater.

It is recommended that handheld multimeters are not used for resistance testing of insulating flanges. Although it is understood that there may be multimeters with a capability to undertake this testing, they do not typically apply sufficient test energy to be effective in determining flange resistance, and may therefore falsely show a flange as having adequate resistance. However, should a potentially suitable multimeter be identified, it is recommended that users take care to verify that the equipment meets the strict interpretation of the recommendations contained in this Section before carrying out the tests.

17.5.5.3 Safety

Testing should be undertaken with instruments and methods selected to be compatible with any hazardous area associated with the location of the flange. Where testing of an insulating flange is carried out in a hazardous area with testing equipment not certified for use in such an area, the testing should be performed under the control of a Permit to Work (see Section 19.1.3).

17.6 Earthing and Bonding Practice in the Terminal

Earthing and bonding minimises the dangers arising from:

- Faults between electrically live conductors and non-current carrying metalwork.
- Atmospheric discharges (lightning).
- Accumulations of electrostatic charge.

Earthing is achieved by the establishment of an electrically continuous low resistance path between a conducting body and the general mass of the earth. Earthing may occur inherently through intimate contact with the ground or water, or it may be provided deliberately by means of an electrical connection between the body and the ground.

Bonding occurs where a suitable electrically continuous path is established between conducting bodies. Bonding may be achieved between two or more bodies without involving earthing, but more commonly earthing gives rise to bonding with the general mass of the earth acting as the electrical connection. Bonding may arise by construction through the bolting together of metallic bodies, thus affording electrical continuity, or may be by the provision of an additional bonding conductor between them.

Most earthing and bonding devices intended to protect against electrical faults or lightning are permanently installed parts of the equipment which they protect, and their characteristics must conform to the national standards in the country concerned, or to classification societies' rules, where relevant.

The acceptable resistance in the earthing system depends upon the type of hazard that it is required to guard against. To protect electrical systems and equipment, the resistance value is chosen so as to ensure the correct operation of the protective device (e.g. cut out or fuse) in the electrical circuit. For lightning protection, the value depends on national regulations, and is typically in the range of 5-25 ohms.

17.7 Vigilance Control (Dead Man's Switch)

A **dead man's switch** is a switch that is automatically operated in case an operator becomes incapacitated. At some terminals this switch has been installed to guard the loading or unloading operation. Normally, if the dead man's switch is not reset at regular intervals an alarm will be activated. If this alarm is not acknowledged within a limited time, the cargo operations will be stopped automatically.

If a vigilance control system is installed, it is recommended that:

a) the switch should be remotely controlled

b) if remote control is not possible, the 'continuation' button should at least be in a portable box positioned on the tanker so as to be readily accessible.

c) to prevent confusion with any other buttons or switches provided by the terminal, the continuation button should be distinctly and clearly marked)

d) during tanker discharging, the vigilance alarm should not initiate automatic closure of the terminal's valve because of the associated pressure surges that could result.