- **Padding**: To prevent any oxidation or As per local/ terminal/ shipper requirement
- **Inerting:** To prevent flammability hazard

Nitrogen 'Drying, Purging, Padding or Air-blow are high risk operations and if not properly carried out may result in significant damage to Cargo tanks due to over pressurization.

6CT.5.1.4 GUIDELINES ON NITROGEN PURGING

Nitrogen purging is carried out prior loading to bring the tank atmosphere to the desired level. This is normally done by connecting up the loading arm/hose to the cargo manifold and passing Nitrogen through the cargo lines into the empty cargo tanks.

Venting shall be allowed only through butter-worth pocket or purge pipe or though VRL to shore.

During venting it should be ensured that outlet diameter is greater than inlet diameter of the gas.

The flow rate of gas in m^3/hr is a function of the pipe diameter and pressure in the pipe.

Hence for the same flow rate the pressure in a larger pipe will be much less as compared to that in a smaller diameter pipe.

Below table shows the volume of Nitrogen that can be received in one minute through a known pipe diameter at known pressure.

Hose Dia / Pressure	200 mm (8")	150mm (6")	100mm (4")	50mm (2")	25mm (1")
5.2 bar (75 psi)	1,771 (106,000)	914 (55,000)	343 (20,600)	67 (4,000)	12 (740)
3.4 bar (50 psi)	1,286 (77,000)	662 (39,700)	243 (14,600)	48 (2,900)	9 (530)
2.1 bar (30 psi)	886 (53,000)	457 (27,400)	171 (10,300)	33 (2,000)	6 (360)
0.7 bar (10 psi)	471 (28,300)	214 (12,900)	80 (4,800)	16 (1,000)	3 (170)

Table 1 - Cubic metres of gas at various gauge pressures received in 1 minute (and 1 hour) through hoses of various sizes.

Table 2 illustrates the time taken to receive gas into a tank at different pressures and hose sizes. The example used assumes a cargo tank of 1,250 cubic meters requiring four atmosphere changes, i.e. 5,000 cubic meters of nitrogen, to flow through.

Hose Dia / Pressure	200mm (8")	150mm (6")	100mm (4")	50mm (2")	25mm (1")
5.2 bar	3 min.	5½ min.	15 min.	1 ¼ hrs.	7 hrs.
3.4 bar	4 min.	7 ½ min.	21 min.	1 ¾ hrs.	10 ½ hrs
2.1 bar	5 ½ min.	11 min.	29 min.	2 ½ hrs	
0.7 bar	11 min.	24 min	63 min.	5 ¼ hrs.	

Time to receive 5,000 m^3 of gas with various gauge pressures and hose sizes.

Refer to Nitrogen Handling Checklist (**S – 6CT.4 C**) for relevant Nitrogen purging precautions.

6CT.5.1.5 GUIDELINES ON NITROGEN PADDING

Whenever a cargo is required to be carried under a pad of Nitrogen, and it is necessary to use nitrogen supplied from shore, ***it is strongly preferred to purge the entire tank before loading. After such purging of the tank, loading the cargo under closed conditions will automatically create the needed pad within the tank.*** Risk of over-pressurization can be substantially reduced by avoiding padding with shore supplied nitrogen.

However, if the cargo is required to be carried under additional Nitrogen pad after loading or if shippers insist on padding their cargo after loading, the required nitrogen pad will have to be supplied by the vessel or shore using a low volume / low pressure source. As padding is very often done against a small or limited ullage space (volume), pressure can therefore build up very quickly if something fails.

To control the shore nitrogen flow rate, a ***hose having a maximum diameter of one inch (1") or Orifice of one inch (1") is to be connected between the shore supplied nitrogen and the ships manifold.*** This will ensure that the flow rate will be maintained at a minimum.

In case of bubbling through toxic cargoes using 1" hose/ Oriface connected at the manifold, tank openings other than vapour return line shall be kept closed.

Record keeping:
S – 6CT.4 C - Nitrogen Handling Checklist

The system is charged with thermal oil by taking suction from the storage tank. The system is kept re-circulating between the re-circulating pump, heat exchangers, through the heating coils in the cargo tanks, back to re-circulating pump suction.

On the return line, one branch is given which leads to the expansion tank which compensates for the expansion of the liquid due to rise in temperature. An overflow line is fitted on the expansion tank which leads to the storage tank. An overhead expansion tank is fitted and connected to the system. This compensates for liquid expansion as well as keeps maintaining a positive head.

6CT.2.11.3 HEAT EXCHANGERS

Some ships are provided with heat exchangers and instead of installation of heating coils inside cargo tanks, cargo needs to be pumped on deck and passed through heat exchangers when heating is required. Heat exchanger consists of primary and secondary heating medium and minimizes risk of cargo contamination.

Heat exchangers are provided with blanking facility at inlet/return and requires thorough cleaning after heating cargo being discharged.

Pressure testing frequency – 3 months, including visual inspection of the tubes to confirm no unnecessary cargo remnant deposits, which will reduce heat exchanger efficiency.

6CT.2.12 CARGO TANK PRESSURE SENSORS

Many vessels are fitted with pressure sensors with alarm facility for cargo tanks to comply with the SOLAS Secondary venting requirements and / or to avoid over/under pressurization of cargo tanks. It is important that the set points of these alarms are properly set so as to provide the necessary alarms in good time. Same should be adjusted depending upon whether vessel is carrying out:

1. Loading with vapour return
2. Loading by venting to atmosphere through High Velocity Vents

6CT.2.12.1 GUIDANCE NOTE ON PRESSURE SENSOR ALARM SETTINGS:

Following tank pressure alarm settings shall be used by the vessel depending upon vessel operation for the cargo transfer operation:

Tank Atmosphere	High Pressure Settings	Low Pressure Settings
Inerted Vessel	10% above the normal actuation settings of Pressure Valve	Above Zero (Tank should never be allowed to fall below Zero)
Non Inerted Vessel		10% above the normal actuation settings of Vacuum Valve
VRL (Inerted Vessel)	Not more than 90% of the normal actuation settings of Pressure Valve	Not less than 100 mmWG or (0.144 PSI)
VRL (Non Inerted Vessel)		Not less than lowest Vacuum Valve setting