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## Risk Element

- Asphyxiation;
- Explosion;
- Refrigerant Burns;
- Slips Trips & Falls;
- Manual Handling;
- Noise;
- Lone Working;

## PPE Requirements

- Suitable Nitrile Gauntlets;
- Safety Glasses / Goggles;
- Overalls;
- Safety Footwear;
- Hearing Protection – Plugs / Defenders.

## Precautions to Eliminate/Reduce Risk

- CO<sub>2</sub> is heavier than air so falls and lies in low points. Detector sensors to be located in low points;
- CO<sub>2</sub> operates at very high pressures. Ensure plant / cylinders etc. are not overfilled. At 15 °C the pressure of CO<sub>2</sub> is 51 bar g (R404A is 8.5 bar g);
- Ensure correctly rated regulators are used for charging and pressure testing;
- Suitable Nitrile Gauntlets to be worn when handling CO<sub>2</sub> where there is the possibility of release;
- Keep work areas clean and tidy and free from obstruction. Note potential trip hazards and clean up any spills etc.;
- When manual handling any equipment, plant or materials ensure the correct, trained manual handling techniques are used;
- Hearing protection is made available and must be used where the noise assessment has identified the requirement for its use;
- Any employee who is lone working must adopt the company lone working procedure;
- This may include any site control measures.

## Action in an Emergency

- Shut off leak and evacuate area, if there is no risk;
- Switch off electrical supply;
- Remove cylinders from heat source, keep cylinders cool;
- General first aid in cases of accident.

## Safe Working Method

Personnel must be familiar with plant operation and wear required PPE - protective gloves, safety glasses / goggles, overalls, safety footwear and hearing protection (plugs / defenders).

### Ensure Correct Tools are Used

- Nitrogen Pressure Regulator (175 bar);
- CO<sub>2</sub> Regulator (175 bar);
- Suitable Gauge Manifold (200 bar);
- Suitable Leak Detector.

### Evacuation / Disposal

- Do not recover into cylinders;
- Vent slowly to a well ventilated area.

Be aware of “Dry Ice” formation in system and in vent line when approaching the triple point (4.2 bar g and below). It is good practice to have the relieving device at the end of relieving line (due to the possible high relieving pressure, this valve must be properly supported). It is possible to use heating elements in the relieving valve to make sure it does not block with dry ice.

### Charging CO<sub>2</sub>

- Ensure a safe system charging point is available;
- Prevent thermal shock, charge slowly;
- Only charge system with gas until pressure in system is above triple point (above 4.2 bar g);
- Charge with liquid above triple point (above 4.2 bar g system pressure);
- Be aware that at the triple point the temperature is approximately -56 °C and thermal shock is a possibility;
- Steel / copper tubing and steel braded hoses are to be used at all times;
- DO NOT trap liquid in service lines or system components (between valves etc.). Liquid or gas expands rapidly (for every 1 °C temperature rise an approximate 1 bar g pressure rise occurs where there is room for expansion);
- Be aware that if there is not room for expansion the pipe will hydraulic and the pressure could be in excess of 100 bar g.

### Pressure Testing

- Strength Test Pressure = 1.1 x PS;
- Up to 165 bar g Trans Critical system;
- Up to 44 bar g Cascade system;
- Tightness Test Pressure = 1.0 x PS.

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