株式会社 鈴木商館
SUZUKI SHOKAN CO.,LTD.

Bath-cooled liquid nitrogen circulation cooling system for crystal monochromators

Introduction

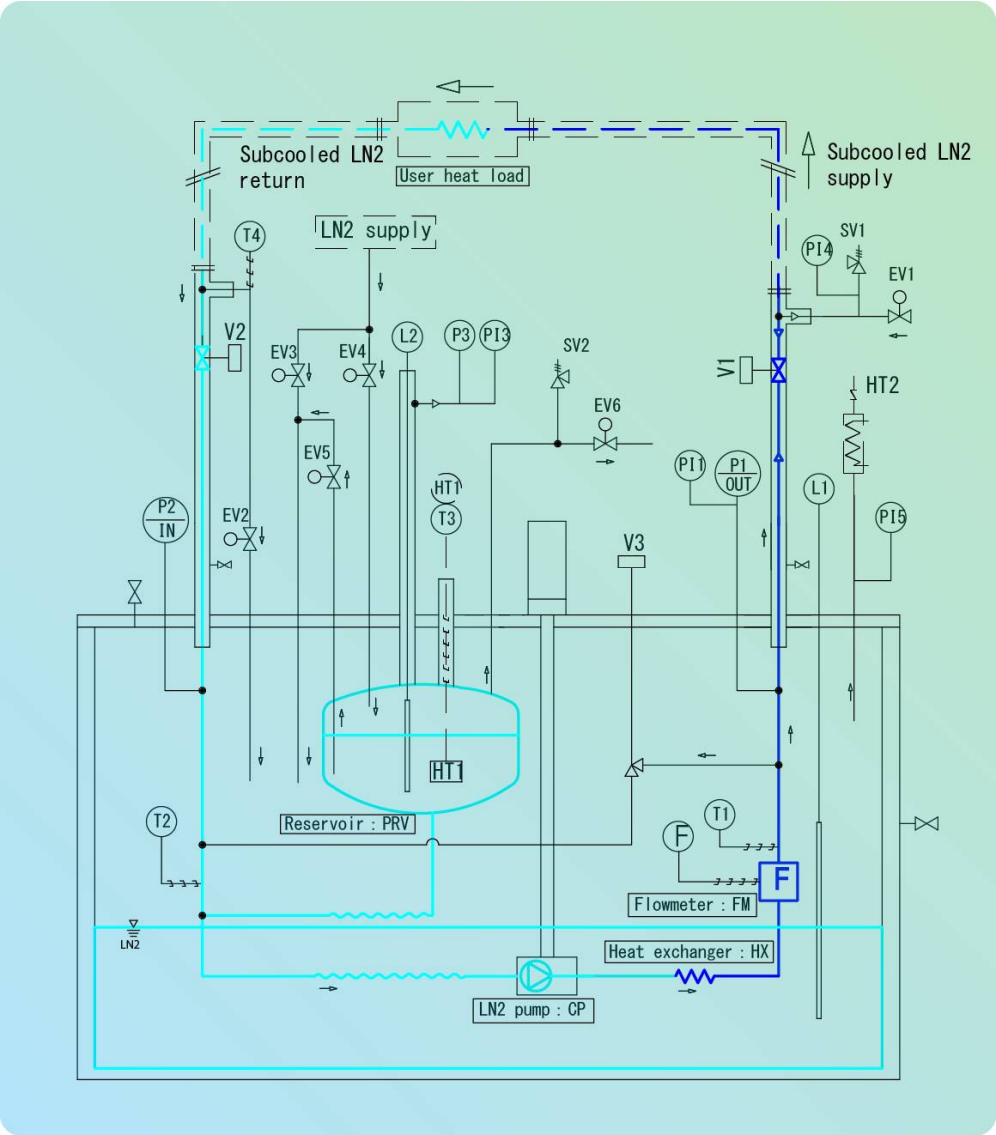
Suzuki Shokan Co., Ltd. (SSK) has been developing liquid nitrogen (LN2) circulation cooling systems for more than 10 years and is proud to propose its own design on the international stage. More than 40 systems have been successfully installed in a variety of experimental equipment and industrial devices, including cooling systems for High-Temperature Superconducting (HTS) power distribution cables, HTS coils, as well as synchrotron devices and crystal monochromators.

The LN2 circulation cooling system proposed by SSK.

Presentation of the circulation cooling system

The SCLL-2500 proposes a fully equipped solution for cooling the customer's monochromator crystal upon a continuous heat load of up to 2,500 W. The closed-loop circuit of the refrigerant allows a precise control of the parameters essential to a stable and efficient cooling, such as flow rate, pressure and temperature.

By the use of a reservoir acting as an inner buffer, the needs for replenishing the circulating cryogen are minimized and hence allow to keep the purity of the cooling medium. The stability of the fluid is ensured by a subcooled operation, meaning the



Flow diagram of the SCLL-2500

liquid nitrogen is submitted to a slightly pressurized atmosphere in the reservoir, preventing it from boiling and thus from creating vibration around the monochromator's crystal. By varying the pressure in the reservoir, it is possible to change the temperature of the whole circulating loop.

A Barber Nichols liquid nitrogen pump is at the center of the circulator and allows a controllable flow rate with very low vibration and heat invasion. The pump can flow up to 25 L/min at no load, through the coil copper heat exchanger and then through the vacuum-jacketed pipes leading to the customer's monochromator.

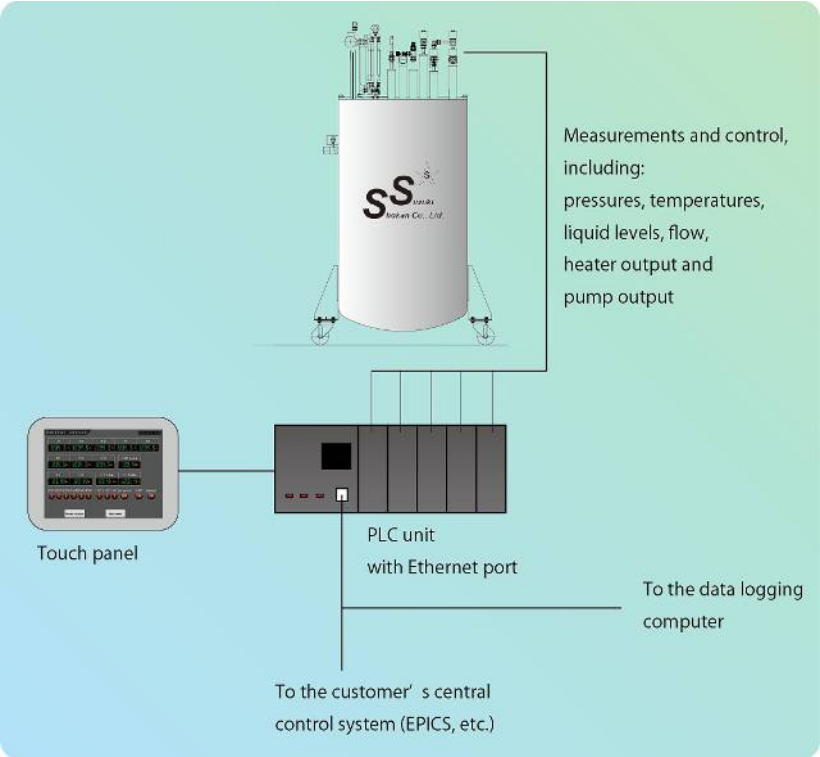
The bath of liquid nitrogen at atmospheric pressure absorbs the heat transferred from the monochromator crystal to the circulation cryogen by evaporation.

The flow is smooth, controllable and continuously monitored to give the customer a safe and reliable system, usable by all and fully automated.

Interface

The operation of this monochromator cryocooler relies on a Programmable Logic Controller (PLC) with touch panel for possible direct monitoring or manual action on the line. It comes equipped of an Ethernet module for all necessary communication with a host PC or any common control network used in most synchrotrons to allow remote control and monitoring. The PLC itself ensures the automation of the system and the detection of the alerts, which are then transferred to the central control system through the communication ports.

Example of menu accessible through the touch panel.



Block diagram of the interface network

Specifications

Cooling power	Up to 2.5 kW
Operating temperature	78 – 95 K
N2 gas operation pressure	0.2 – 0.8 MPa
Flow rate	5 – 25 L/min at no load
Temperature stability	< 0.1 K
Pressure stability	< 1 kPa
LN2 consumption under operation	2 L/hour at no load
	62 L/hour under 2.5 kW of heat load

Dimensions	Body (LN2 container)
	H 2,000 mm x ϕ 700 mm
	Control rack 19”
	H 1,500 mm x W 570 mm x D 650 mm

Controls	Auto-refill of the LN2 reservoir through control of the liquid level Auto-refill of the LN2 bath from an external Dewar or the customer's LN2 supply circuit (various possible connections) Precooling: manual operation of the valves or automated by PLC Warming up: manual operation or automated by PLC Flow control through PLC touch panel or remote configuration Pressure control through touch panel or remote configuration Ethernet port for communication with the control system chosen by the user (EPICS, etc.)
Monitoring	Circulating LN2 flow rate Pressures: reservoir, LN2 supply channel, LN2 return channel Temperatures: LN2 supply, LN2 return, reservoir, monochromator exit, flowmeter Liquid levels: reservoir, bath All the measurements above are recorded by the PLC with possibility of transferring data to outer devices. Compatibility with equipment protection systems.
Miscellaneous	Lockable casters for smooth and precise installation. Manufacture in accordance with the Japanese High Pressure Gas Safety Act on demand Optional vacuum port to lower the temperature of the LN2 bath. Vacuum-jacketed pipes between cryocooler and monochromator sold separately, please ask for quotation.
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