Pneumatic Target Transfer System Model PT01

Technical Data Sheet

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REVISION HYSTORY

No.	Description	Made by	Date
1.	Modifications made reflecting the Rev. 2 of the system	J. Čomor	2016/04/18
2.	Communication between PTS and ACS described in detail	J. Čomor	2018/02/22

VALIDATION HISTORY

	Created by	Verified by	Validated by
Name:	Jožef Čomor	Đuro Jovanović	Jožef Čomor
Date:	February 22, 2018	February 22, 2018	February 22, 2018
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ELEX Commerce has an established Quality Management System according to ISO 9001:2015 standard

Short description of the system

PT01 is a fully automatic pneumatic target transport system, which provides for one-way transfer of solid target disks irradiated in the Nirta Solid Compact® target station into hot cells for further radiochemical processing.

The system uses a powerful blower for generating under-pressure, which transfers the sealed and locked capsule with the target disk. This way the system is inherently safe, i.e. radioactive particles released from the target cannot enter the atmosphere of the installation.

The system has four main sub-systems: the robotic target handling station, the control cabinet with the PLC-based control and safety system, the blower station and up to five airlocks for inserting the capsules with the target disks into the hot cells.

The control system of the pneumatic transfer system can be integrated into the control system of the cyclotron.

Specifications of the pneumatic target transport system	
Target disk dimensions	Max. Ø24×2 mm
Disk material	Platinum, silver, copper, etc.
Number of receiving hot cells	Max. 5
Maximum distance from the target station to the hot cell	35 m
Mode of operation	Automatic, semi-automatic and manual
Built-in safety and interlock functions	YES

Dimensions and weight	Size (W×D×H)	Weight
Robotic target handling station	63 × 51 × 140 cm	35 kg
Control box	50 × 50 × 20 cm	10 kg
Blower station	65 × 70 × 38 cm	25 kg

Dimensions and weight	Size (W×D×H)	Weight
Airlock	28 × 28 × 100 cm (of these 100 only 37 cm is in the hot cell)	10 kg

Power requirements	Voltage (VAC)	Current (A)
Control box	220 – 240 (50-60 Hz)	6

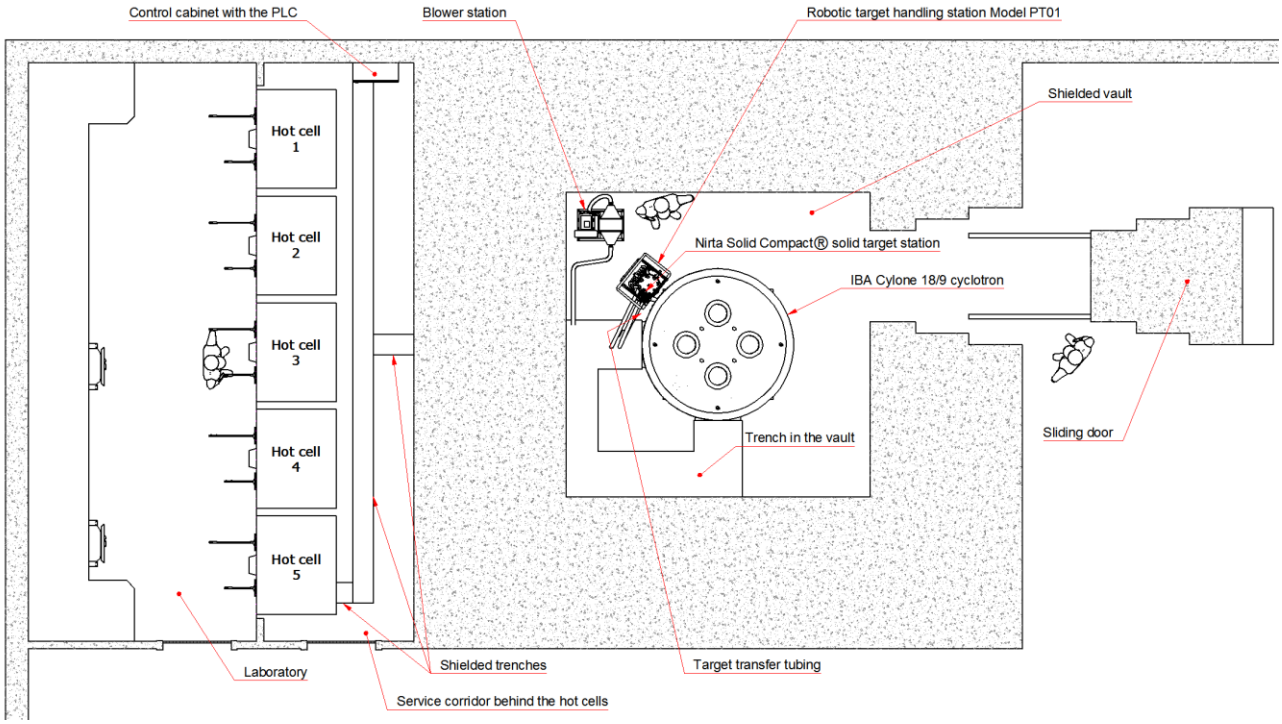
Site requirement specifications

General specifications

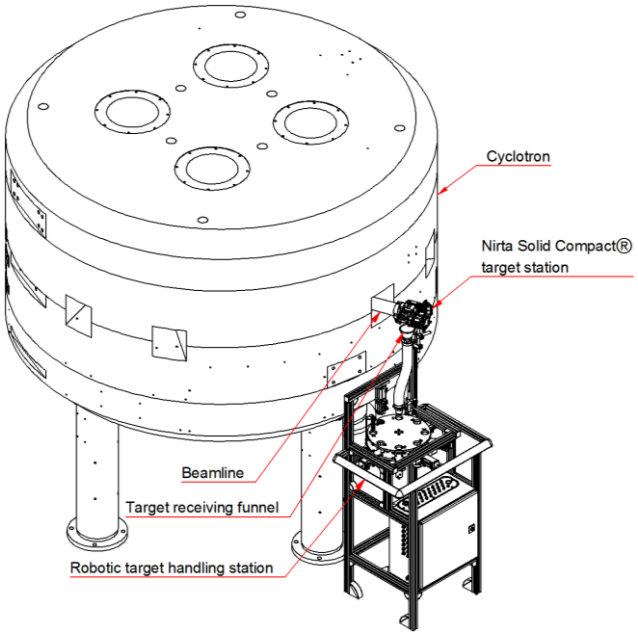
The following terms and conditions should be fulfilled for a successfull installation:

1. The local shielding around the airlock (located below the hot cell) and the tube for the rabbit (layed down in trenches) is not supplied by ELEX. The required lead bricks should be provided by the end user or the supplier of the hot cell.
2. The local shield around the airlock and transfer tubes should be built from min. 50 mm thick lead bricks.
3. The dimensions shown are the minimum internal dimensions within the local shield. The actual local shield can be bigger (and thicker).
4. The airlock (below the hot cell) and the receiving station (inside the hot cell) are to be installed on the same flange welded to the bottom of the hot cell's internal containment. Sufficient space should be provided around the receiving station inside the hot cell and through the opening through the shielding of the bottom of the hot cell. The flange on the bottom of the hot cell should be welded to the containment of the hot cell prior to the installation of the transfer system.
5. The local shielding around the airlock bellow the hot cell should be well fixed, in order to prevent that it collapses in case of an earthquake.
6. The receiving station shall be directly accessible by the right ball-tong manipulator. There should be no equipment placed in front of the receiving station (i.e. between the ball tong and the receiving station).
7. The receiving station shall be clearly visible through the lead window on the front side of the hot cell.
8. The control system of the hot cell shall provide an interlock signal in form of a dry relay contact with the following functionality:
    a. CLOSED CONTACT means the hot cell is ready to receive the rabbit;
    b. OPEN CONTACT means the hot cell is not ready to receive the rabbit.
9. This relay should be of normally open type, i.e. in case of power failure it shall provide an open contact.
10. For the connection of the airlock it is necessary to weld a flange onto the floor of the inner containment of the hot cell as specified on the following drawings.

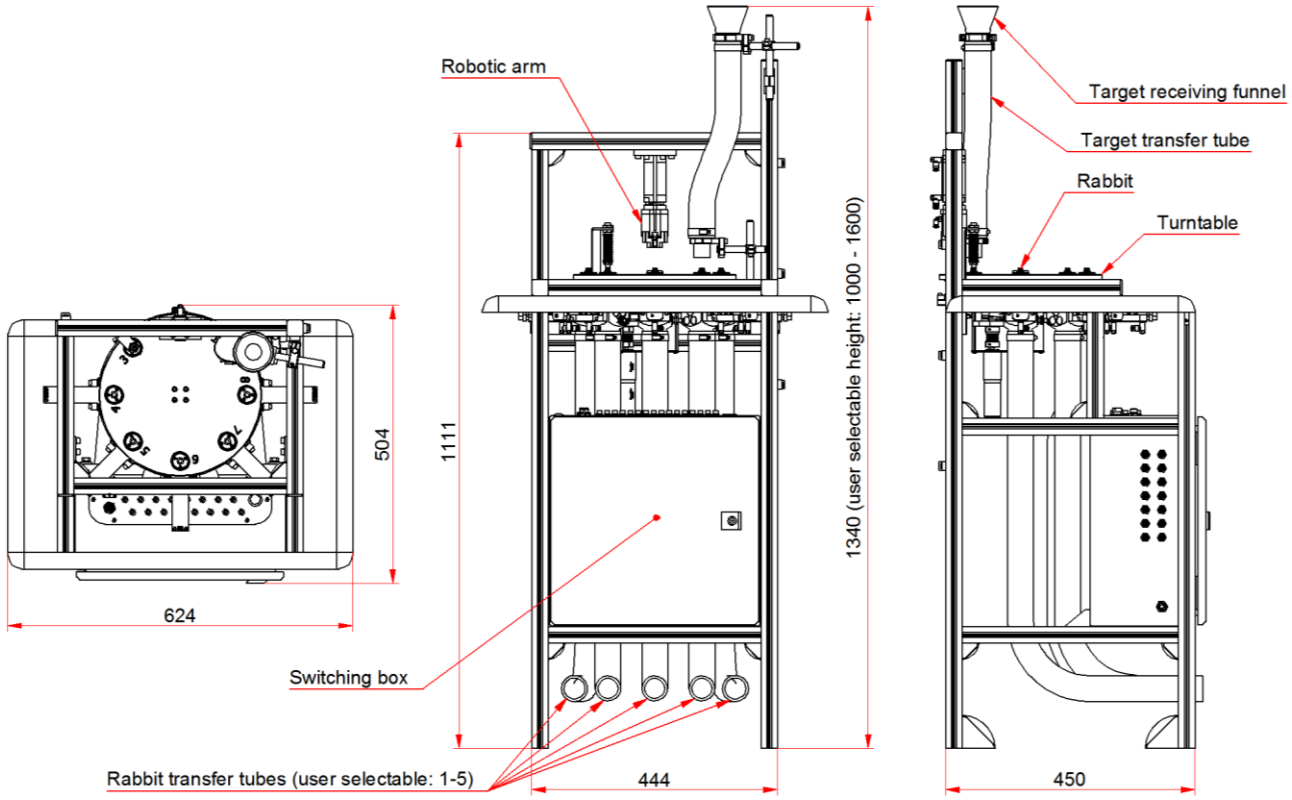
11. There should be an opening in the lead shielding bellow the floor of the hot cell around this flange as indicated in the following drawings. This opening can be circular or square.
12. The distance from the lower face of the containment of the hot cell to the floor and from the lower face of the lead shielding to the floor shall be communicated to ELEX as early as possible.
13. The control system of the target transfer system should be integrated into the control system of the cyclotron through a number of relay input/output contacts as explained at the end of this TDS.



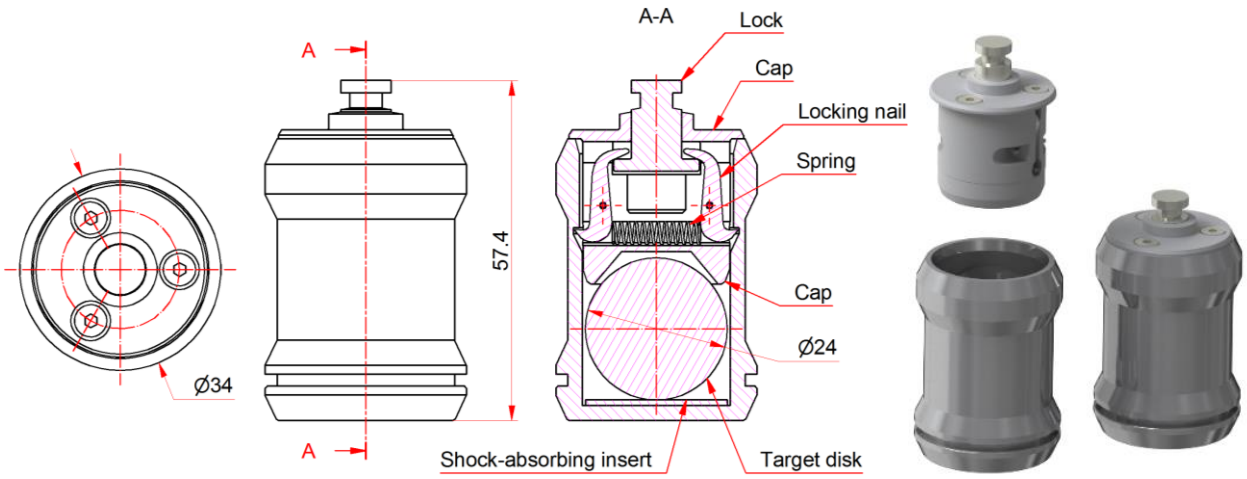
General layout of a typical facility



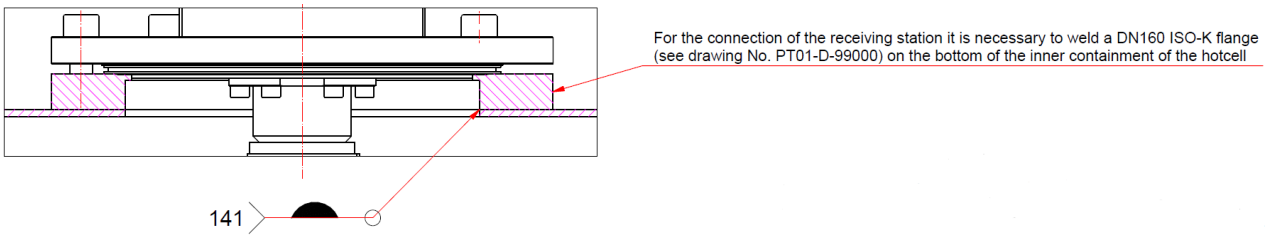
The robotic target handling station installed below the target station



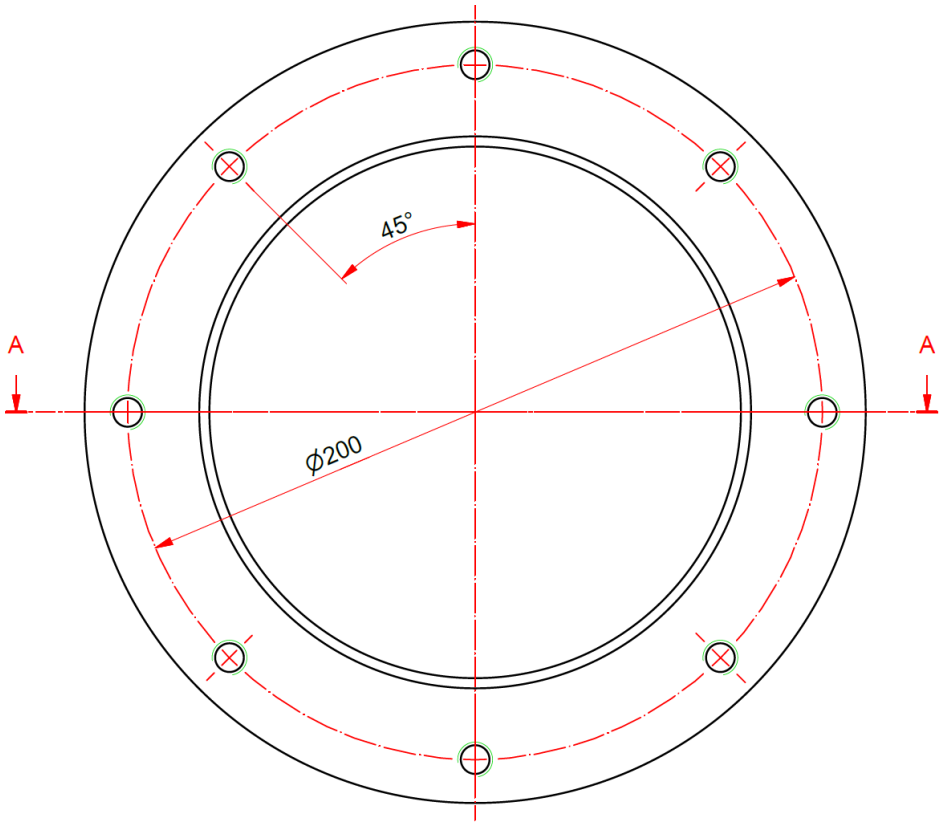
Robotic target handling station



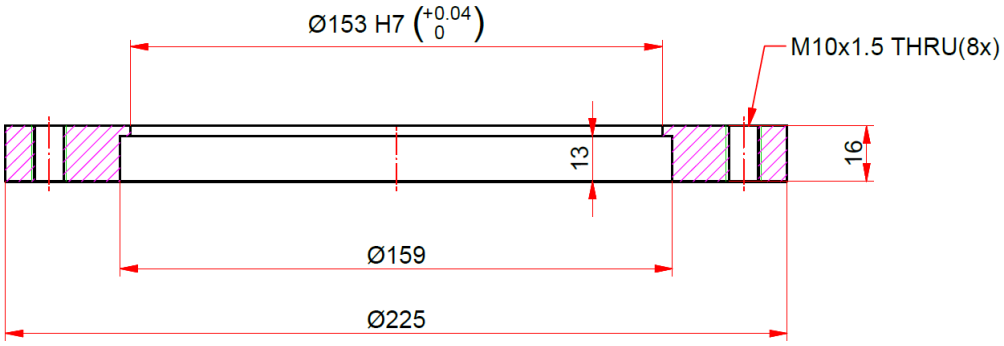
Target transport capsule (self-locking type)



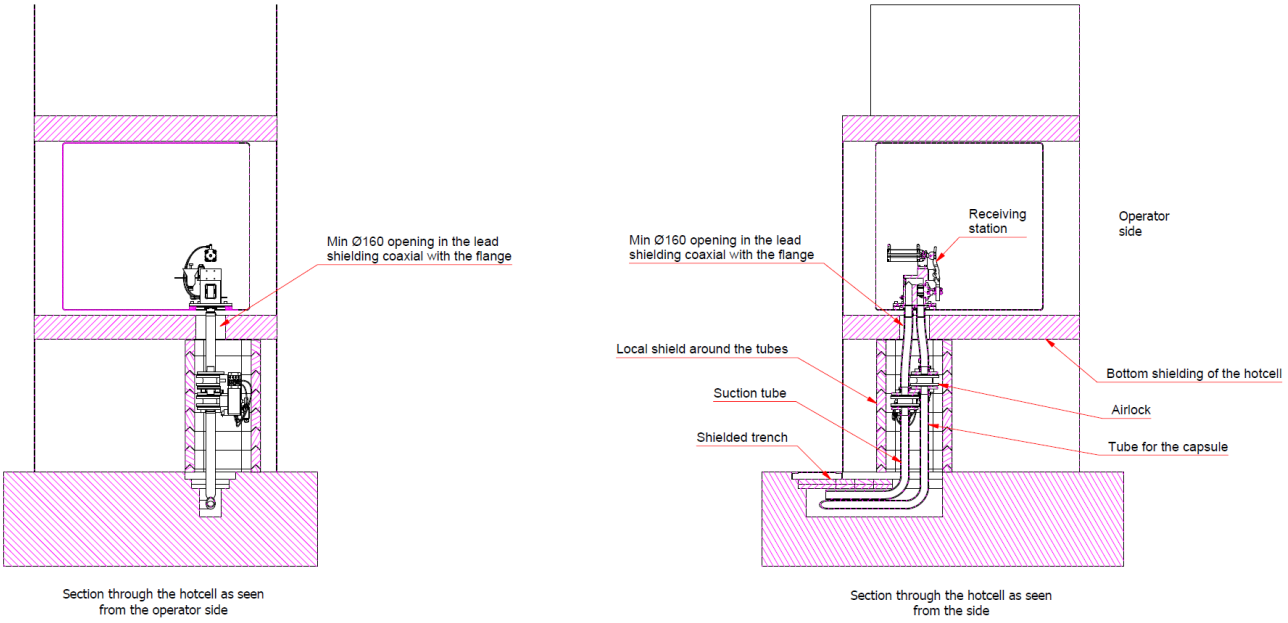
Drawing explaining how to weld the flange to the bottom of the hot cell's containment (the orientation of the tapped holes (not visible in this cross section) is irrelevant, since the receiving station can be continuously rotated around the central axes of the flange before fixing it by 8 M10 bolts



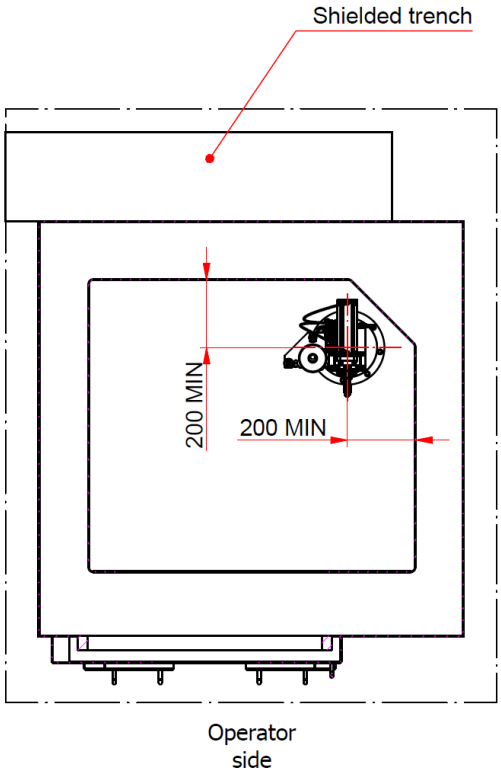
A-A



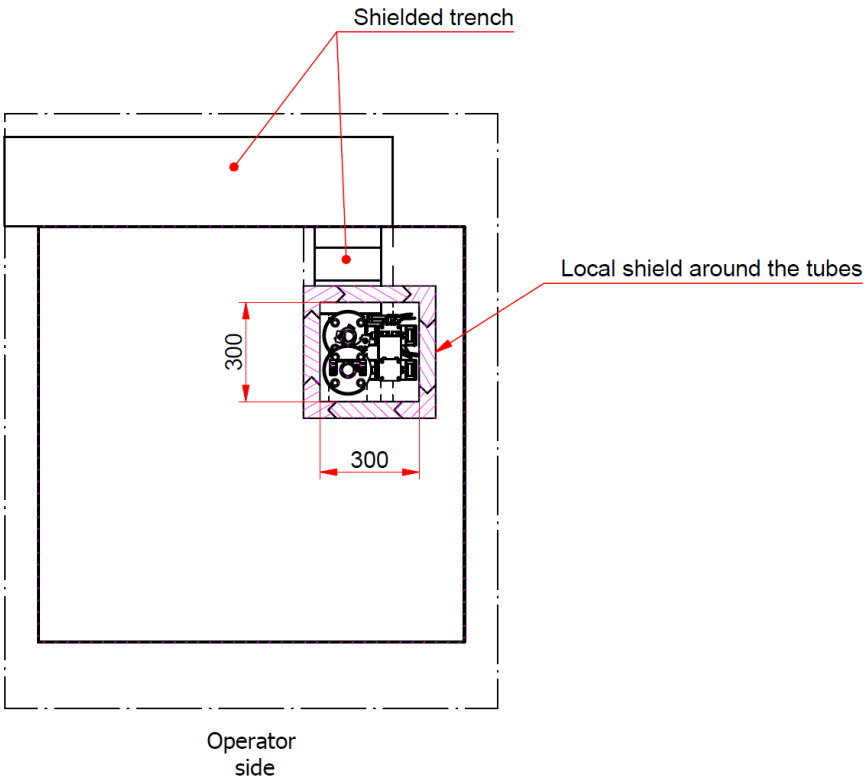
Production drawing of the flange to be welded to the bottom of the containment of the hot cell for the installation of the receiving station (all dimensions are in mm)



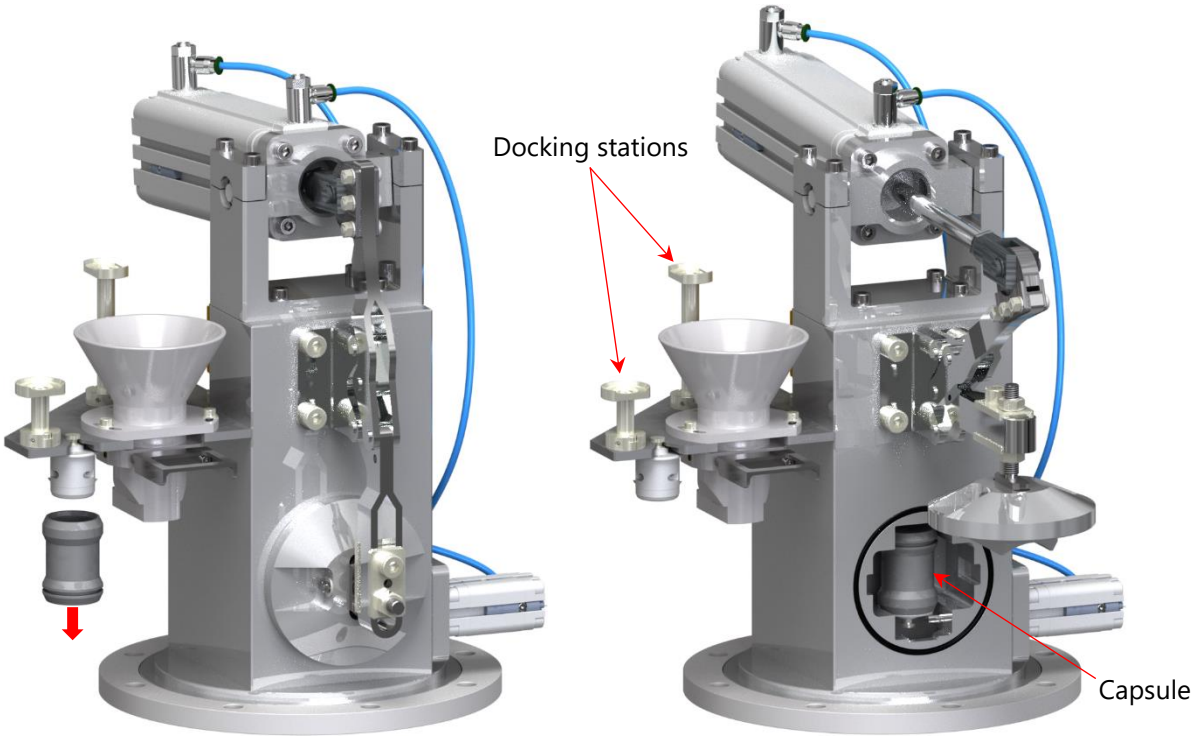
Sectional view through the hot cell showing the position of the receiving station in the containment of the hot cell as well as the location of the airlock with the corresponding lead shielding



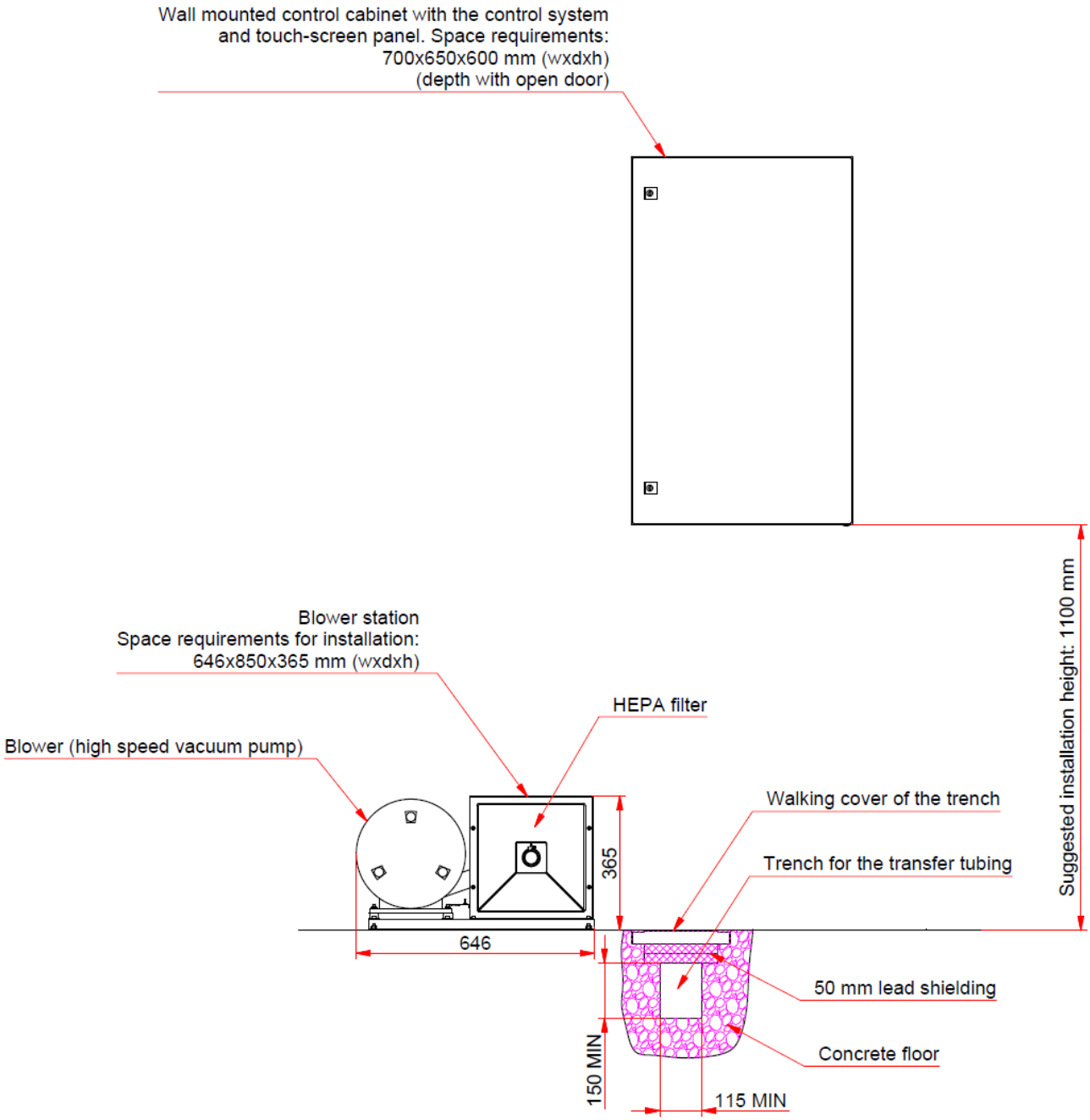
Positioning of the flange for the installation of the receiving station: horizontal sectional view through the hot cell (the dimensions are indicating the distance between the center of the flange to the inner walls of the hot cell; the receiving station should be positioned into the right-rear corner of the containment)



Building the lead shielding around the airlock below the hot cell. The dimensions are indicating the minimum space required for the airlock. The shielding can be easily built from standard lead bricks using standard-size components.

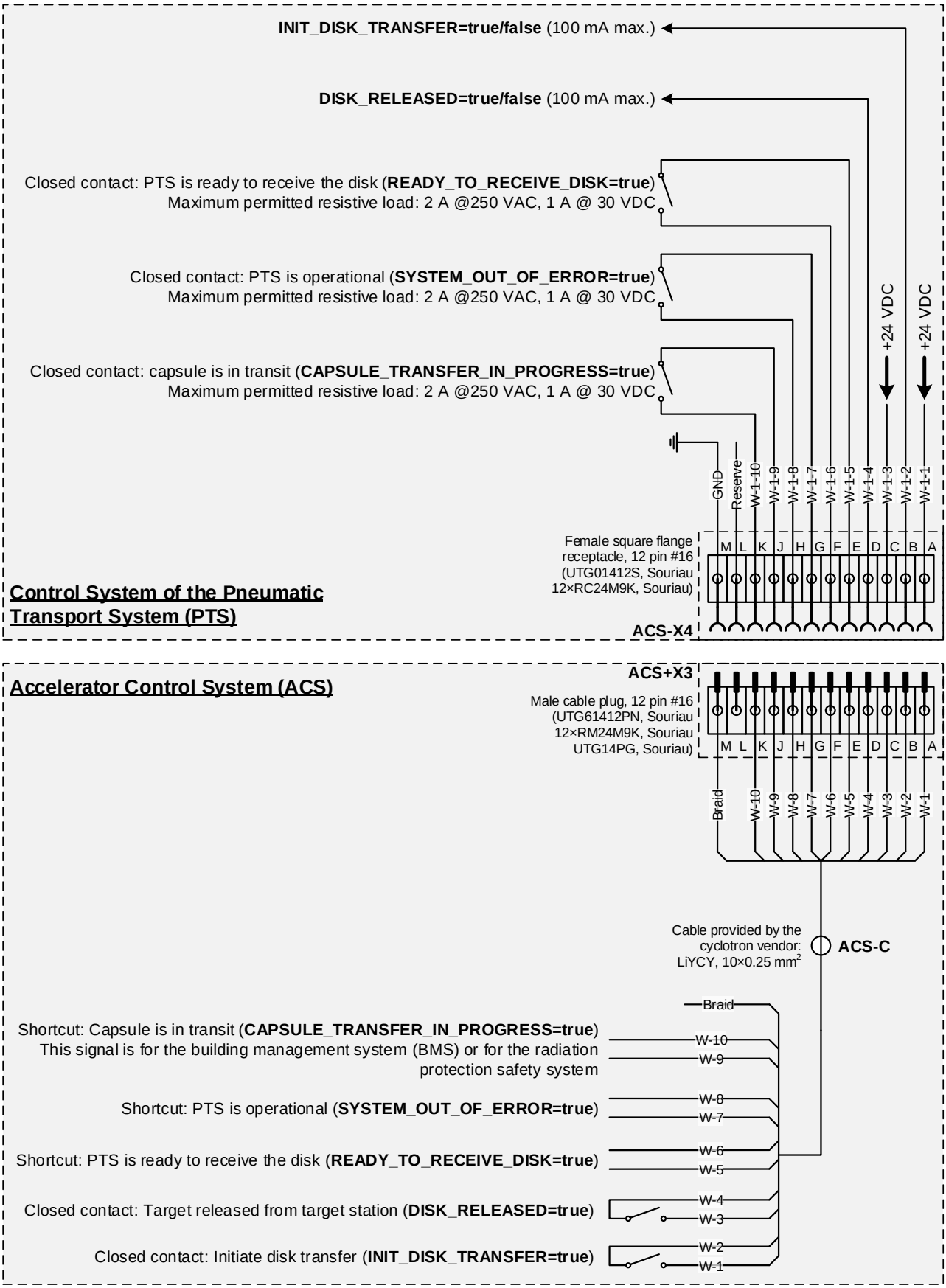


The target receiving station. Left: closed, right: open station (the capsule is visible after it arrived into the station). The caps can be removed by hanging the capsules in the dedicated recess and pulling the body downwards. The target disk can be poured out from the capsule into the funnel, from which it can be grabbed by the ball-tong manipulator. There are two docking stations for turning the target disk up-side-down.



Disposition and dimensions of the blower station, shielded trench for tubing and control cabinet

The control cabinet should be connected to the control system of the cyclotron (Accelerator Control System, ACS) in order to integrate the operation of the pneumatic target transport system into the control software of the cyclotron. This will allow to the cyclotron operator to initiate the transfer and to visualize the status of the transport system on the control screen of the cyclotron. There is a dedicated connector on the bottom of the control cabinet, which can be used to connect the cable, which can be laid-down between the two systems. The following drawing provides all relevant information for making such a cable (not in the scope of delivery of the pneumatic transport system) and it describes also the functionality of the communication between the two systems.

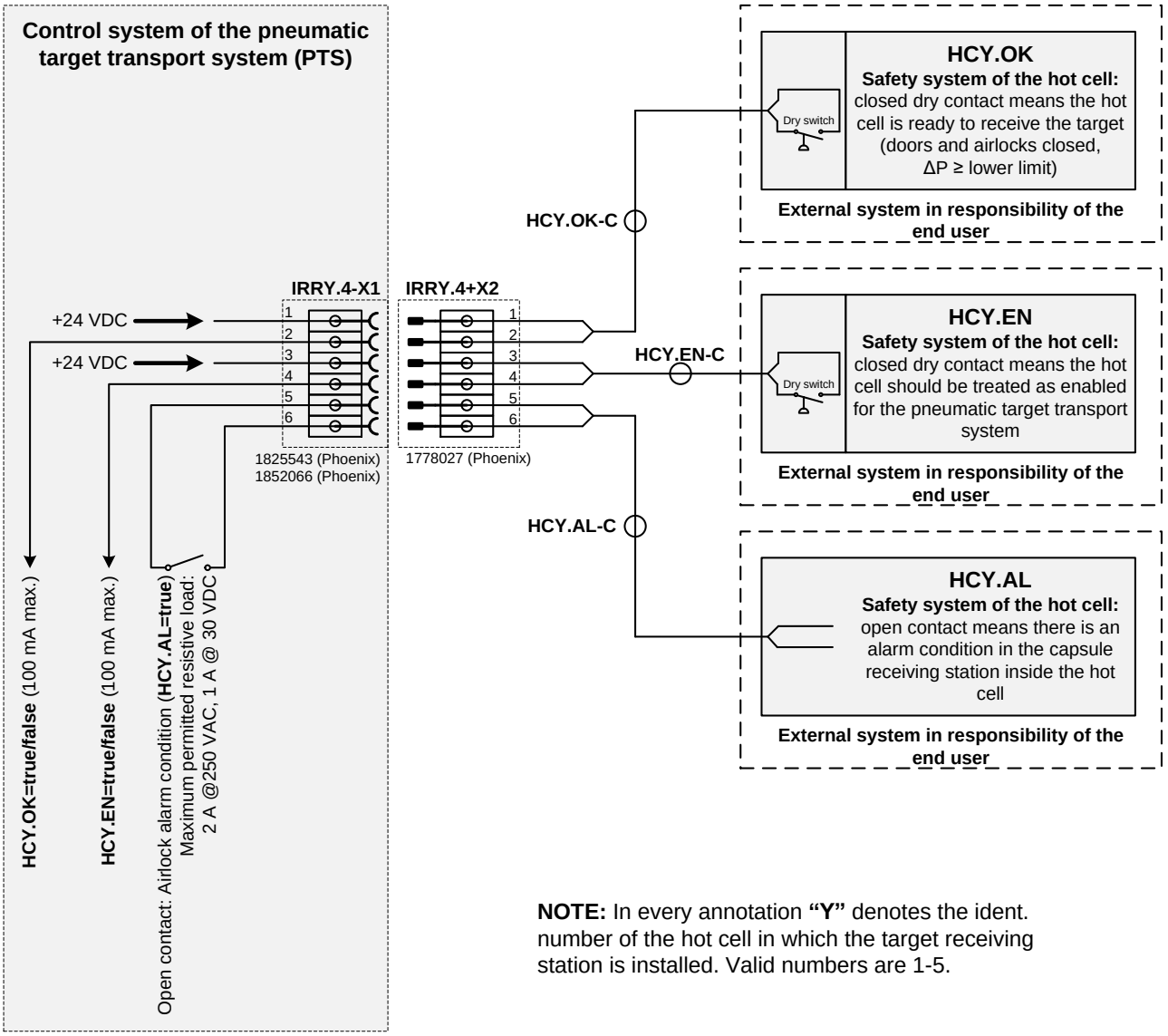


Specifications of the communication cable between the control system of the pneumatic transport system (PTS) and the control system of the cyclotron (ACS).

The control system of the pneumatic transport system can also communicate to individual hot cells. In order to prevent that radioactive material is sent into the hot cell while it is not ready for safely receiving radioactive materials (e.g. the shielding door is not closed, the under-pressure in the containment is not appropriate, there is already too much activity in the hot cell, etc.) the delivery of the capsule into any of the hot cells can be interlocked by a safety interlock provided by the hot cell's safety system. Such an interlock should be a dry contact (e.g. relay contact), which status will be understood by the control system of the pneumatic transport system in the following way:

- OPEN CONTACT: the hot cell is not ready to receive the capsule.
- CLOSED CONTACT: the hot cell is ready to receive the capsule.

This contact, provided by the hot cell, can be transmitted to the control system through a dedicated screw-in-wire connector one can find on each airlock. Using a two-wire cable one should connect the relay contact of the safety system of the hot cell to pins 1 and 2 of the connector on the airlock, as indicated in the following drawing.



Schematics of the interconnection of safety interlocks between the hot cell and the pneumatic transport system.

The control system of the pneumatic transport system provides one more useful feature. Namely, in case the hot cell is out of operation for certain time (during service and maintenance or break-down), it can be completely excluded from the operation of the transport system with a second interlock. This interlock signal (dry contact) could be provided by a key operated switch mounted onto the operating panel of the hot cell. The status of this contact will be understood by the control system of the pneumatic transport system in the following way:

- OPEN CONTACT: the hot cell is not available – exclude it from the list of available hot cells.
- CLOSED CONTACT: the hot cell is available – include it into the list of available hot cells.

This safety interlock (hot cell available/not available) can be connected to the same connector of the airlock, using pins 3 and 4 as indicated in the previous drawing.

Finally, the control system of the pneumatic transport system is providing a dry contact to external users (systems), which can be used as an alarm signal. Namely, if the airlock of the capsule receiving system is malfunctioning and the safety system detects the situation that the door of the receiving station is open and at the same time at least one of the ball valves of the airlock is not closed, the control system will activate a relay and open a dray contact, which is connected to pins 5 and 6 as indicated in the previous drawing. This open contact between pins 5 and 6 can be used by the safety system of the hot cell for instance to activate an alarm (audio and/or visual alarm). Indicating that the tightness of the hot cell is compromised.