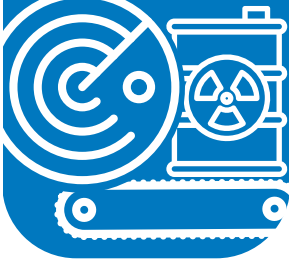


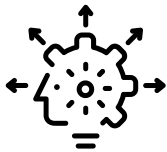


ELSE
NUCLEAR



ADAMOS Series

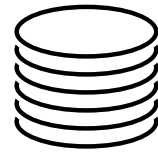
AUTOMATED DRUM MONITORING SYSTEM



Versatile scanning
geometry



Worldwide standard system
for waste characterisation



Sub-sections scanning
procedure

Detector: HPGe, plastic
scintillators, NaI(Tl)

Automatic drum centring
and weighting

Drums up to 500 l, 2500 kg,
density up to 2 g/cm³

Monte Carlo calculated
efficiency matrices

SW for activity measurement

Hot spot detection

ADAMOS is an automated segmented gamma scanning system, designed to characterise drums filled with radioactive waste. The system layout can be defined from the available options to meet specific requirements.

ADAMOS stations are composed of:

- Mechanical structure: rugged steel frame with roll-gang conveyors
- Detection equipment: moving and collimated detectors, typically HPGe
- Management software: user-friendly operator interface

During the automatic scanning procedure, the drum is moved to a rotating platform in the measuring chamber, to be centred and weighted. Then the detectors are vertically moved to intercept and scan the pre-set sub-sections of the total drum volume: a collimator set defines the detector field of view. The suitable measurement setup is automatically selected and applied by the software according to the radioactivity level.

All the actuations and safety devices of the system are locally managed by a PLC; an operator panel is available as user interface.

ADAMOS work cycle is managed by the system software, which sends commands to the PLC to start each macro operations, and constantly checks the system status to detect failures or anomalous conditions.

ADAMOS systems implement the “safety by design” principle to prevent any harm to operators and the system itself. **ADAMOS** stations are typically equipped with perimeter protections, emergency buttons and collision-proximity sensors.

MECHANICAL BASE COMPONENTS

Each ADAMOS station can be composed of a combination of the following base mechanical part.

Modular array of conveyor sections

The typical dimensions are 260 x 132 cm, but can be defined case-by-case.

Each ADAMOS station can be equipped with the needed quantity of conveyors, which can be used to form a transportation array for many drums or just a single loading/unloading section.

The system activates the conveyors to perform the foreseen cycle steps, such as drum transportation to the measurement chamber.

Lifting-rotating platform

The typical dimensions are 160 x 132 cm.

This is the central conveyor module, located in the measurement chamber. It is equipped with a weighting system and a cross-shaped lifting-rotating device, which is used to lift and put the drum into rotation.

The automatic centring procedure includes the use of optic position sensors: the drum is first aligned along the X direction, then lifted and rotated by 90°, and aligned along the Y direction.

Measurement chamber and detector frame

The measurement chamber is defined by the central rotating platform and the detector frame, the dimensions of which are typically 152 x 130 x 240 cm, but can vary according to the measurement equipment.

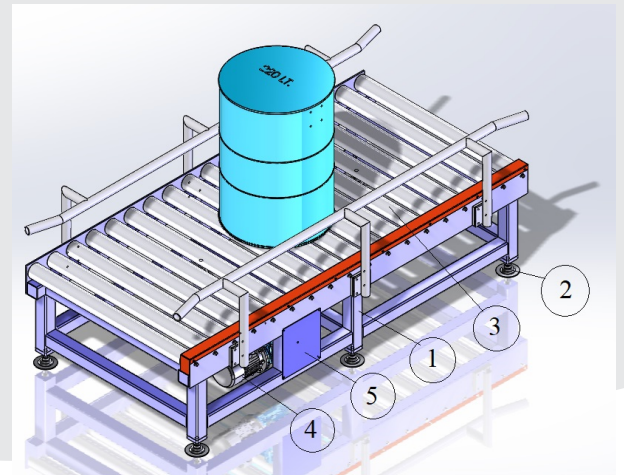
The HPGe detector is installed on a vertically moving shelf, activated by the system to intercept pre-defined sub-sections of the drum and perform a multi-step scanning procedure.

The vertical positions are automatically selected by the system according to the drum type (dimensions and geometrical features, set into the system as parameters).

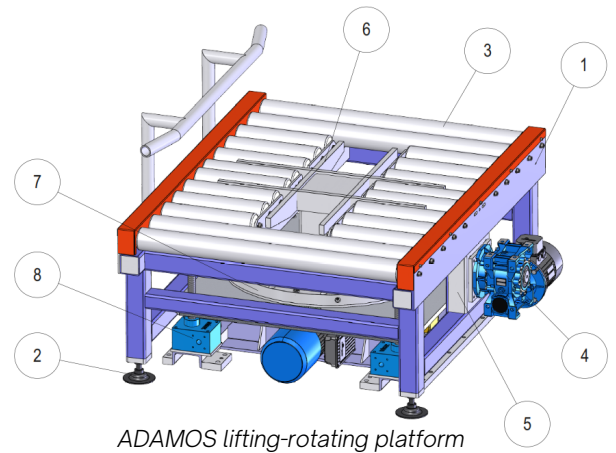
Mechanical specifications

The following characteristics are mostly representative, as they can vary according to the ADAMOS configuration.

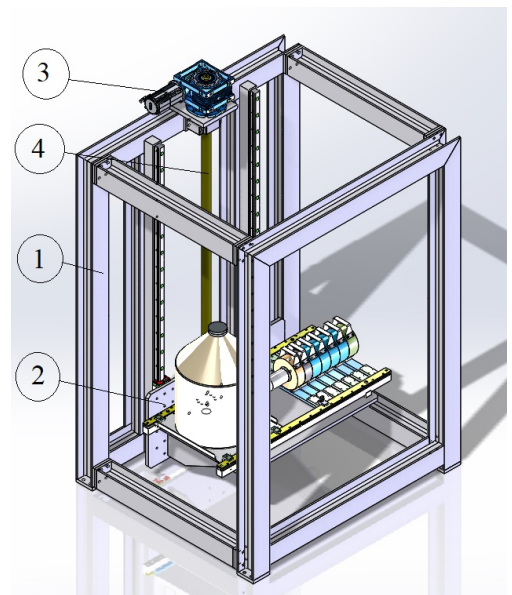
- Modular conveyors (each): 250 kg
- Central platform: 1000 kg
- Detector frame: 1000 kg
- Electric axes (each): 230 kg
- Switchboard: 200 kg
- Weighting station max. payload: 2500 kg
- Weighting precision: ± 2.5 kg



ADAMOS modular conveyor



ADAMOS lifting-rotating platform



ADAMOS detector frame

DETECTION EQUIPMENT

The ADAMOS stations are typically equipped with a high-efficiency, collimated HPGe detector, coupled to an MCA, installed on a vertically moving shelf.

The HPGe can be combined with other detectors, such as:

- a fast gamma measurement device based on Geiger-Muller detectors, used to assess the dose rate and consequently suggest the best measurement setup (collimation-wise)
- a gross gamma preliminary scanning equipment, composed by large plastic scintillators
- NaI(Tl) scintillators to perform gross spectrometric analysis as an alternative to the HPGe detector

HPGe features

- Energy range: from 30 keV to 7 MeV
- FWHM for Co-60 (1332.5 keV): ≤ 2.3 keV
- Efficiency: from 15% to 150% (Nitrogen-cooled), from 50% to 150% (electro-cooled)
- Cooling type: electro-cooling or Nitrogen-cooling

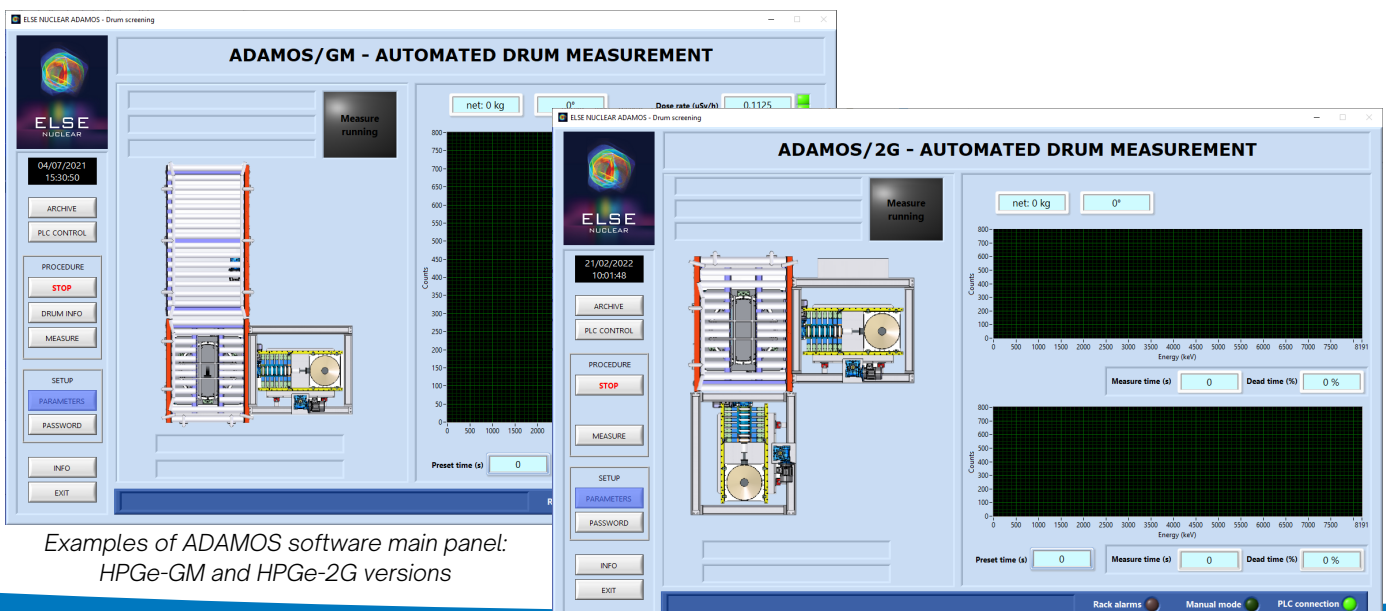
MDA references (HPGe 50% efficiency)

| Nuclide | MDA (120 kg, 500 kg/m ³) | | MDA (340 kg, 1500 kg/m ³) | |
|---------|--------------------------------------|----------------|---------------------------------------|----------------|
| | T = 4 h [Bq/g] | T = 8 h [Bq/g] | T = 4 h [Bq/g] | T = 8 h [Bq/g] |
| Mn-54 | 3,79E-03 | 1,90E-03 | 2,99E-03 | 1,49E-03 |
| Co-60 | 3,33E-03 | 1,66E-03 | 2,46E-03 | 1,23E-03 |
| Sb-125 | 1,34E-02 | 6,72E-03 | 1,12E-02 | 5,61E-03 |
| Cs-134 | 3,94E-03 | 1,97E-03 | 3,2E-03 | 1,60E-03 |
| Cs-137 | 3,58E-03 | 1,79E-03 | 2,88E-03 | 1,44E-03 |
| Eu-152 | 1,30E-02 | 6,48E-03 | 9,51E-03 | 4,75E-03 |
| Eu-154 | 7,54E-03 | 3,77E-03 | 5,61E-03 | 2,81E-03 |
| Am-241 | 1,23E-01 | 6,31E-02 | 1,41E-01 | 9,37E-02 |
| U-235 | 9,13E-03 | 4,56E-03 | 8,26E-03 | 4,13E-03 |

MANAGEMENT SOFTWARE

The system acquires the gamma spectra of the material contained in the drums to determine the activity concentrations. The system efficiency is pre-calculated by means of **MONTE CARLO** simulations based on the measurement set-up and the density of the drum content. The measurement report may include information about correlated isotopes concentrations and possible hot-spot locations.

The operator can interact with the system through an ELSE NUCLEAR proprietary, user-friendly graphic-interface software for data analysis, visualization and storage, which allows to manage the mechanical activations as well as the measurement steps. The software manages the alarm and malfunctioning statuses and the measurements results, archiving the scanning reports in the PC and providing a print if desired.

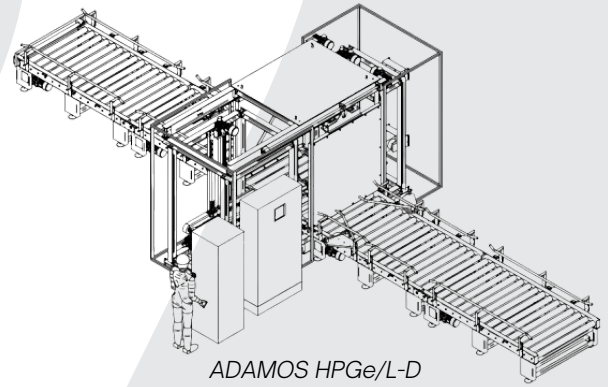


Examples of ADAMOS software main panel:
HPGe-GM and HPGe-2G versions

SYSTEM COMPOSITION EXAMPLES

ADAMOS HPGe/L-D

This version has **2 loading and 2 unloading conveyors**, placed before and after the measurement chamber, respectively. The measurement chamber is equipped with one **HPGe detector**. In addition, this version is equipped with a **density measurement system** (custom design) that employs a Na-22 source (as low as 370 MBq) to provide the density data of each sub-section of the drum. This can be extremely useful in case of non-homogeneous materials. The source is installed in a shielded lodging and then automatically pulled out in front of the drum.



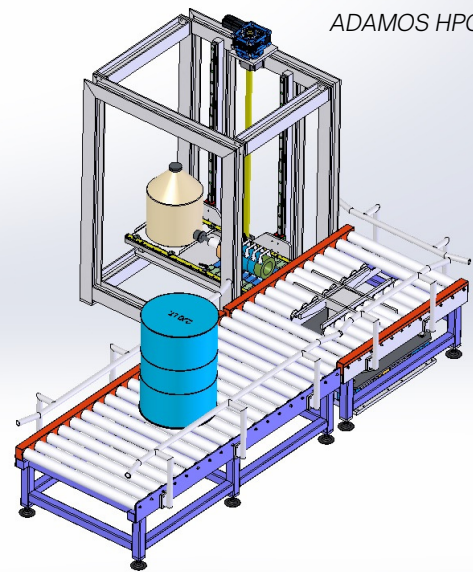
ADAMOS HPGe/L-D

ADAMOS HPGe/U

This version is similar to the /L-D one, but is equipped with an U-shaped array of **4 loading and 4 unloading conveyors**, able to house up to 8 drums for batch measurements.

ADAMOS HPGe-GM

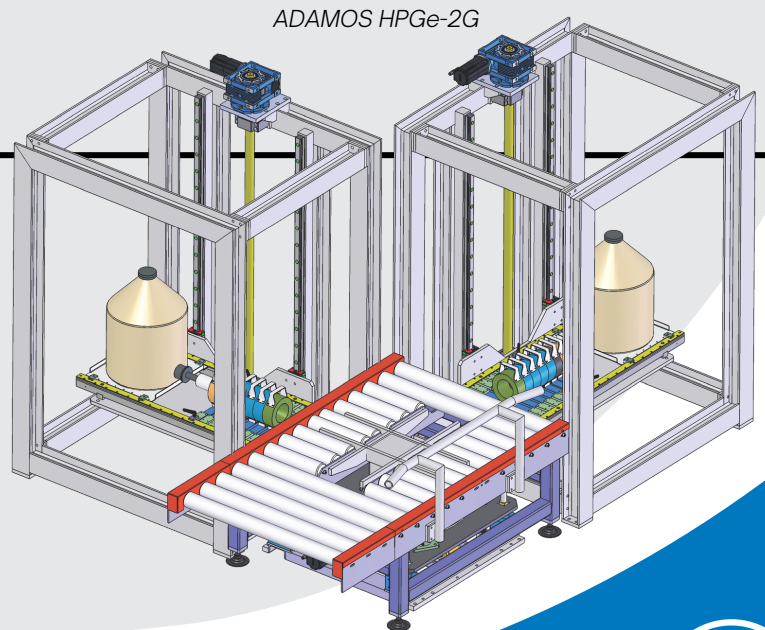
This version is very much similar to the -2G one, but only **one HPGe detector** is installed, whereas this version has **one conveyor module** acting both as loading and unloading platform. Moreover, this version has a **Geiger-Muller-based fast scan detector** used to assess the dose rate, related to the activity level of the drum, and consequently advise the best HPGe collimation to be used.



ADAMOS HPGe-GM

ADAMOS HPGe-2G

This version has **2 HPGe detectors** in a 90° geometry around the measurement chamber, and **no loading/unloading conveyors**. This particular version also has a **customisation of the central platform**, which has been designed to provide additional space before the lifting platform where the drum can be positioned.



ADAMOS HPGe-2G

OPTIONS

ADAMOS systems can be configured to meet specific requirements. The customisation can be applied to the mechanical layout of the conveyors and/or to the measurement equipment.

