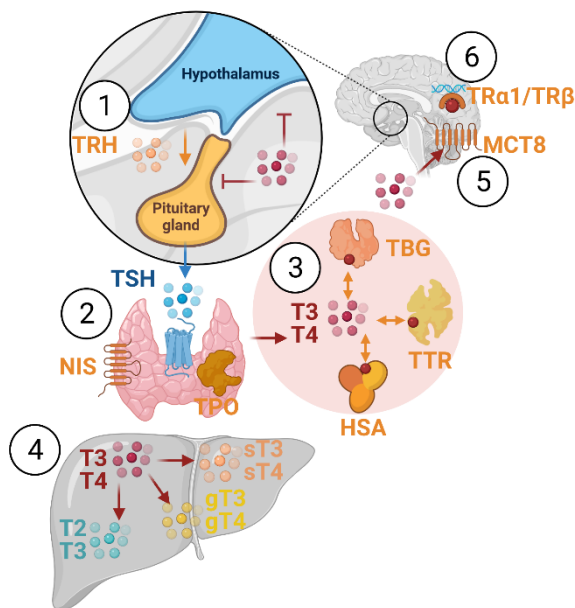


# STANDARD OPERATING PROCEDURE

## Handling, Maintenance and Quality Control of the GH3 cell line, version 2.0

*EURL ECVAM validation study of a battery of mechanistic methods relevant for the detection of chemicals that can disrupt the thyroid hormone system*

Roszak J.



This Standard Operating Procedure (SOP) has been prepared within the context of a collaboration agreement with the Joint Research Centre (JRC) Directorate for Health, Consumers and Reference Materials (Chemicals Safety and Alternative Methods Unit F3 / EURL ECVAM), for the validation of mechanistic methods to identify potential modulators of thyroid hormone signalling. It aims to provide evidence-based scientific support to the European policymaking process. The contents of this publication do not necessarily reflect the position or opinion of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication. For information on the methodology and quality underlying the data used in this publication for which the source is neither Eurostat nor other Commission services, users should contact the referenced source. The designations employed and the presentation of material on the maps do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

This SOP is part of a series of 3 SOPs used to perform the "T-screen assay measuring cell proliferation of GH3 cells using alamar blue/resazurin":

1. SOP "T-screen assay measuring cell proliferation of GH3 cells using alamar blue/resazurin" v2.0 (used in Part 2 of the validation study)
2. **SOP "Handling, Maintenance and Quality Control of the GH3 cell line " v2.0** (used in Part 2 of the validation study)
3. SOP "Determination of cell proliferation in T screen assay" v2.0 (used in Part 2 of the validation study)

The method was developed by Arno Gutleb, LIST (Luxembourg) and subsequently implemented by the EU-NETVAL test facility NIOM (Poland) within the validation study. For the purpose of running the method on a robotic platform during part 2 of the validation study, EURL ECVAM prepared a 4<sup>th</sup> SOP.

4. SOP "T-Screen assay using a QUANTITATIVE HIGH THROUGHPUT screening approach" v1.0 (used in Part 2 of the validation study)

#### Contact information

##### Method developer:

Arno Gutleb  
PhD, ERT  
Luxembourg Institute of Science and Technology (LIST)  
Environmental Research and Innovation (ERIN) Department  
41, rue du Brill  
L-4422 Belvaux  
Grand-duchy of Luxembourg  
Tel: +352 275 888 481  
e-mail: arno.gutleb@list.lu

##### EU-NETVAL facility

Joanna Roszak  
National Center for Alternative Methods to Toxicity Assessment (CMA)  
Department of Translational Research  
Nofer Institute of Occupational Medicine  
91-348 Lodz, 8 Sw. Teresy St, POLAND  
e-mail: Joanna.Rozsak@imp.lodz.pl  
<https://www.imp.lodz.pl/krajowe-centrum-metod-alternatywnych-do-oceny-toksycznosci>

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JRC133179

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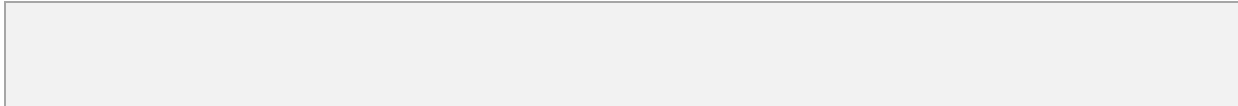
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# Standard Operating Procedure

## Handling, Maintenance and Quality Control of the GH3 cell line

**Author:** EU-NETVAL laboratory NIOM, Joanna Roszak  
**Version:** 02  
**Date:** 27.12.2021



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43 **1. Scope of the SOP**

44 A rat pituitary tumour cell line (GH3) is the test system for T-screen assay. This Standard Operating  
45 Procedure describes how to handle and maintain the GH3 cells and the quality control to be  
46 performed. The GH3 cell line should fulfil acceptance criteria for absence of microbiological  
47 contamination and *Mycoplasma sp.* and the doubling time (Td).

48 **1.1 Safety**

49 All activities related to the culture of GH3 cells (except for counting cells in Bürker chamber) should  
50 be performed under sterile conditions under a laminar chamber.

51 **1.2 Test System**

- 52 • GH3-cell line – a rat pituitary tumour cell line (ATCC® CCL-82.1™)

53 **1.3 Apparatus and Materials**

- 54 • Clean glass vials for the preparation of stock solutions (e.g. gas chromatography vials or  
55 Sarstedt #86.1509)
- 56 • 96-well microplates (e.g., Nunc # 167008)
- 57 • Freezer below -16 °C
- 58 • Freezer below -70 °C
- 59 • Freezer below -135 °C or a liquid nitrogen tank
- 60 • Refrigerator 2-10 °C
- 61 • CO<sub>2</sub> humidified incubator at 37°C +/- 2 °C, 5% CO<sub>2</sub> +/- 0.5%
- 62 • 37 °C water bath
- 63 • Pipette Aid
- 64 • Pipettors (e.g. p1000-100, p100-10, p10-0.5)
- 65 • Centrifuge
- 66 • Vacuum aspirator
- 67 • Sterile Laminar Flow Hood
- 68 • Culture Flasks (T75, T25; e.g. Nunc, Falcon)
- 69 • Serological pipettes (1-2 mL, 5 mL, 10 mL, and 25 mL)
- 70 • Sterile, filter pipette tips (e.g. 10 µL, 200 µL, and 1000 µL)
- 71 • Sterile, pipette tips without filter (e.g. 10 µL, 200 µL, and 1000 µL)
- 72 • Conical tubes (5 mL, 15 mL, and 50 mL)
- 73 • Syringe filters (0.22 µm)

74 **1.4 Reagents and Chemicals**

- 75 • Foetal calf/bovine serum (e.g. Gibco #10270106)
- 76 • Dulbecco's modified Eagle's medium/Ham's Nutrient Mixture F-12 (DMEM/F-12; 1:1 mixture  
77 with phenol red and HEPES (15 mM) (e.g. Sigma-Aldrich#D6421)
- 78 • DMEM/F-12 w/o L-Glutamine, with 15 mM HEPES and w/o phenol red (e.g. Sigma-Aldrich #  
79 D6434)
- 80 • HEPES 1M solution (e.g. Sigma-Aldrich #H0887)
- 81 • Penicillin-Streptomycin Solution (e.g. Sigma-Aldrich #P0781)

- 82 • Bovine insulin (e.g. Sigma-Aldrich #I0516)
- 83 • Ethanolamine (e.g. Sigma-Aldrich #E0135)
- 84 • Sodium selenite (e.g. Sigma-Aldrich #S5261)
- 85 • Human apotransferrin (e.g. Sigma-Aldrich #T2036)
- 86 • Bovine serum albumin (e.g. Sigma-Aldrich #A9418)
- 87 • PBS without Ca<sup>2+</sup>/Mg<sup>2+</sup> (e.g. Biological Industries #02-023-1A)
- 88 • Accutase (e.g. Sigma-Aldrich #A6964)
- 89 • Deionized water (dH<sub>2</sub>O)
- 90 • *Mycoplasma sp.* detection kit (e.g. MycoBlue Mycoplasma Detector; VAZYME# D101-01)

91 **2. Handling and Maintenance of Test System**

92 **2.1. Stock solutions of reagents**

93 **2.1.1. Ethanolamine [50 mM]**

94 Prepare a 50 mM stock solution of ethanolamine in dH<sub>2</sub>O by diluting a pure ethanolamine (16.6 M)  
 95 332x, i.e. 10 µL of ethanolamine (16.6 M) added to 3.310 mL of dH<sub>2</sub>O, and filter (0.22 µm pore size).  
 96 The stock should be prepared freshly before to use or stored at room temperature in closed glass  
 97 containers.

98 **2.1.2. Sodium selenite [50 µg/mL]**

99 Prepare 10x concentrated stock solution of sodium selenite (500 µg/mL) in dH<sub>2</sub>O, then dilute it 10x  
 100 to receive the desired concentration, i.e. 50 µg/mL. Filter stock solution (0.22 µm pore size) and  
 101 store in aliquots below -16 °C.

102 **2.1.3. Human apotransferrin [2 mg/mL]**

103 Prepare the 2 mg/mL stock solution of human apotransferrin in dH<sub>2</sub>O, filter (0.22 µm pore size), and  
 104 store in aliquots below -16 °C.

105 **2.1.4. Bovine serum albumin [100 mg/mL]**

106 Prepare a 100 mg/mL stock solution of bovine serum albumin in dH<sub>2</sub>O, filter (0.22 µm pore size), and  
 107 store in aliquots at 2-8 °C.

108 **2.2. Media**

109 **2.2.1. Cell culture medium (cDMEM/F12; completed cDMEM/F12)**

110 Dulbecco's modified Eagle's medium/Ham's Nutrient Mixture F-12 (DMEM/F-12; 1:1 mixture; with  
 111 phenol red and 15 mM HEPES) supplemented with 10% Foetal calf serum, 2.5 mM L-Glutamine and  
 112 additional amount of HEPES to obtain 25 mM.

113 To prepare cDMEM/F12 the following volume of supplements should be added:

	the final concentration	Volume [mL]
DMEM/F-12 w/o L-Glutamine, with 15 mM HEPES (e.g. Sigma-Aldrich #D6421)*		500
Heat inactivated FCS/FBS**	10%	57.6
200 mM L-Glutamine	2.5 mM	7.2
1 M HEPES	up to 25 mM	5.8
Penicillin-Streptomycin solution (100x)	1%	5.8
<b>Total</b>		<b>576.4</b>

114 \*if different DMEM/F-12 is used the final concentration of HEPES and L-Glutamine should be  
 115 adjusted to 2.5 mM and 25 mM, respectively.

116 \*\* if heat-inactivated FCS/FBS was purchased, it should be defrost at 2-10°C e.g. during the night and  
 117 stored in aliquots at below -16°C.

118 If non-inactivated FCS/FBS was purchased, it should be heat-inactivated in water bath at 56-57°C for  
 119 30-35 min and filtered (0.2 µm) before aliquoting.

120 **2.2.2. Cell cryopreservation medium**

121 Complete cell culture medium described in Section 2.1.1. supplemented with 5% (v/v) DMSO.  
 122 The volume of the freeze medium prepared depends on the amount of vials. To prepare 1 mL of the  
 123 freeze medium mix: 50 µL of DMSO with 950 µL of cDMEM/F12.

124 **2.2.3. PCM medium**

125 PCM medium is a Dulbecco's modified Eagle's medium/Ham's Nutrient Mixture F-12 (DMEM/F-12;  
 126 1:1 mixture) without phenol red supplemented with 10 µg/mL bovine insulin, 10 µM ethanolamine,  
 127 10 ng/mL sodium selenite, 10 µg/mL human apotransferrin, 500 µg/mL bovine serum albumin.  
 128 To prepare *PCM medium* the following volume of supplements should be added:

	Final concentration	Volume [mL]
DMEM/F-12 w/o L-Glutamine, with 15 mM HEPES (e.g. Sigma-Aldrich # D6434)*		500
200 mM L-Glutamine	2.5 mM	6.5
1 M HEPES	up to 25 mM	5.2
Penicillin-Streptomycin solution (100x)	1%	5.2
10 mg/mL bovine insulin	10 µg/mL	0.523
50 mM ethanolamine (Section 2.1.1)	10 µM	0.105
50 µg/mL sodium selenite (Section 2.1.2)	10 ng/mL	0.105
2 mg/mL human apotransferrin (Section 2.1.3)	10 µg/mL	2.6
100 mg/mL bovine serum albumin (Section 2.1.4)	500 µg/mL	2.6
<b>Total</b>		<b>523.0</b>

129 \*if different DMEM/F-12 is used the final concentration of HEPES and L-Glutamine should be  
 130 adjusted to 2.5 mM and 25 mM, respectively.

131 **2.3. Maintenance and handling of GH3 cells**

132 **2.3.1. Restoring GH3 cells**

133 **a. Restoring a purchased vial of GH3 cells**

- 134 1. Thaw the GH3 cells (a purchased vial) according to the supplier's instructions, using the culture  
 135 medium described in Section 2.1.1.
  - 136 2. Seed at the cell density provided on the certificate of analysis.
  - 137 3. Culture GH3 cells at 37 ± 1 °C and 5 ± 0.5% (v/v) CO<sub>2</sub> in a humid atmosphere in cDMEM/F12  
 138 medium
- 139

140 **b. Restoring GH3 cells frozen in the laboratory**

- 141 1. Prepare a tube with 9 mL of cDMEM/F12 medium
- 142 2. Thaw the vial in a  $37 \pm 1^\circ\text{C}$  water bath as rapidly as possible using gentle hand agitation.
- 143 Immerse or spray the vial in 70% alcohol or relevant disinfectant to sterilize outside.
- 144 3. Unscrew the cap of the vial and transfer the contents of the vial to the pre-warmed medium in
- 145 the tube.
- 146 4. Centrifuge 5 min 1500 rpm.
- 147 5. Discard the supernatant
- 148 6. Resuspend the pellet in the fresh warm cDMEM/F12 medium
- 149 7. Transfer all cells into a T25 flask, leaving a small portion of the cell suspension for counting
- 150 Culture GH3 cells at  $37 \pm 1^\circ\text{C}$  and  $5 \pm 0.5\%$  (v/v)  $\text{CO}_2$  in a humid atmosphere in cDMEM/F12 culture
- 151 medium.
- 152 Prepare both a Master Cell Bank (e.g. 10-20 vials) and Working Cell Bank (e.g. 20-30 vials).

153 **2.3.2. Cryopreservation**

154 General protocol of ATCC provides the following instructions:

155 Always harvest cells in exponential growth.

- 156 1. Prepare a freeze medium consisting of complete culture medium and 5% DMSO (Section
- 157 2.2.2). Do not add undiluted DMSO to a cell suspension as dissolution of DMSO in aqueous
- 158 solutions gives off heat (exothermic).
- 159 2. Label the appropriate number of vials with the name of the cell line and the date and the
- 160 passage number.
- 161 3. Collect cells by gentle centrifugation (10 min at  $125 \times g$ ) and resuspend them in the freeze
- 162 medium at a concentration of  $1 \times 10^6$  to  $7 \times 10^6$  viable cells/mL.
- 163 4. Add 1 mL of the cell suspension to each of the vials and seal.
- 164 5. Allow cells to equilibrate in the freeze medium at room temperature for a minimum of 15
- 165 minutes but no longer than 60. This time is usually taken up in dispensing aliquots of the cell
- 166 suspension into the vials. After 60 minutes, cell viability may decline due to the DMSO.
- 167 6. Place the vials into a controlled-rate freeze chamber, such as ATCC ACS-6000, CoolCell
- 168 LX, and place the chamber in a  $-70^\circ\text{C}$  (or colder) mechanical freezer for at least 24 hours.
- 169 Alternately, use a programmable freezer unit set to cool the cryovials at  $-1^\circ\text{C}$  per minute
- 170 until a temperature below  $-70^\circ\text{C}$  is achieved.
- 171 7. Quickly transfer the vials to a liquid nitrogen or a  $-130^\circ\text{C}$  (or colder) freezer. Frozen material
- 172 will warm up at a rate of  $10^\circ\text{C}$  per minute and cells will deteriorate rapidly if warmed above -
- 173  $50^\circ\text{C}$ .
- 174 8. Record the location and details of the freeze.
- 175 After at least 24 hours at below  $-130^\circ\text{C}$ , remove one cryovial, restore the cells in culture, and
- 176 determine their viability and sterility as described in Section 2.3.3.

177 **2.3.3. Quality control to be performed**

178 Before cryopreservation and after restoring the first cryovial of the cell bank; check your cell culture

179 for absence of microbiological contamination such as fungi, bacteria, yeast, which can be verified by

180 microscopic observation after 1-2 weeks culturing of the cells without antibiotics assuring proper

181 safety conditions or out-sourcing.

182 Before cryopreservation and during normal use, check your cell culture for *Mycoplasma sp.*  
183 contamination using a PCR-based mycoplasma detection procedure or out-sourcing.

184 The culture that is contaminated (microscopic observation or a positive result in a mycoplasma  
185 detection kit) should be disposed in accordance with the appropriate system procedure for the  
186 disposal of hazardous wastes. A new frozen vial with the GH3 cells should be used for testing or for  
187 multiplication and cryopreservation.

#### 188 **2.3.4. Detachment of GH3 cells**

189 GH3 cells should be detached by using Accutase.

- 190 1. View the GH3 culture using an inverted microscope to assess the degree of confluency and  
191 confirm the absence of bacterial and fungal contaminants
- 192 2. Remove spent medium and wash the cell monolayer with PBS without  $\text{Ca}^{2+}/\text{Mg}^{2+}$  (5 mL/a  
193 T25 flask or 10 mL/a T75 flask)
- 194 3. Pipette Accutase (RT) into the washed cell monolayer using 1-2 mL/T25 or 3-6 mL/T75.  
195 Gently rotate the flask to cover the monolayer with Accutase.
- 196 4. Return the flask to the incubator and leave for 3-5 minutes.
- 197 5. Examine the cells using an inverted microscope to ensure that all the cells are detached and  
198 floating. DO NOT tap or shake the flask to release any remaining attached cells since it  
199 increases cell mortality.
- 200 6. Add fresh serum-containing medium (cDMEM/F12) to the cells to inactivate Accutase (5  
201 mL/a T25 flask or 10 mL/a T75 flask). In some circumstances, i.e. detachment after  
202 preincubation cells in PCM medium for T-screen test, the PCM medium must be used for  
203 inactivation of Accutase by dilution.
- 204 7. Transfer the content to a new labeled vial and centrifuge the cells 1500 rpm; 3-5 min.
- 205 8. Resuspend the pellet into a known volume of fresh medium cDMEM/F12 and count the cells  
206 using Trypan blue to determine density and viability as described in Section 2.3.6

#### 207 **2.3.5. Passaging of GH3 cells**

208 Passage GH3 cells in T25 or T75 tissue culture flasks every three-four days by using Accutase. Every  
209 two-three days culture medium should be exchanged with the fresh one.

- 210 1. Detach the GH3 cells as described in Section 2.3.4
- 211 2. After determination of density and viability of GH3 cell suspension (Section 2.3.6) transfer an  
212 appropriate number of the viable cells into a new flask. Recommended number of cells to  
213 subculture in 3-4 days is:  
214 -  $6 \times 10^5$  cells/T25 flask ( $5-7 \times 10^5$  cells/T25 flask) or,  
215 -  $1.8 \times 10^6$  cells/T75 flask ( $1.5-2.1 \times 10^6$  cells/T75 flask)  
216 Alternatively, if the cells cannot be counted, then a sub-cultivation ratio of 1:2 to 1:4 is  
217 recommended
- 218 3. Culture GH3 cells at  $37 \pm 1$  °C and  $5 \pm 0.5\%$  (v/v)  $\text{CO}_2$  in a humid atmosphere in culture  
219 medium (Section 2.1.1)

220

221 **2.3.6. Determination of cell suspension density and cell viability**

222 Density and viability of cell suspension is determined in Trypan blue exclusion test using Bürker  
223 chamber. To this end:

- 224 - Take 100 µL representative sample of cell suspension into Eppendorf
- 225 - Add 100 µL Trypan Blue solution
- 226 - Count cell number at least in 3 squares
- 227 - Calculate cell density [cells/mL] using a formula below:

228 **Cell density [cells/mL] = X/Y \* Z \*10000**

229 where,

230 X= the sum of all cells (#) counted in the large squares (min. 3 max 9)

231 Y = the number of the counted large squares

232 Z = dilution in Trypan Blue solution (usually 2x)

233 10000 = conversion factor to 1 mL

234 (#) IMPORTANT! All cells means all viable cells or all/total cell number (viable+nonviable), depending  
235 on the aim of counting. For further culture (passage) or for the test calculate density of viable cells,  
236 whereas for determination of the doubling time total number of cells is counted (density of  
237 viable+nonviable cells).

- 238 - Calculate cell viability [cells/mL] using a formula below:

239 **Viability [%] = X\*100/(X+Y)**

240 where,

241 X = number of viable cells (cells with clear cytoplasm) counted in the large  
242 squares (min. 3 max 9)

243 Y = number of nonviable cells (cells with blue cytoplasm) counted in the  
244 same large squares as X has been counted

245

246 **2.4. Determination of the doubling time (Td) of GH3 cells**

247 Every time when the GH3 cells are restored the doubling time (Td) of GH3 culture should be  
248 determined both in cDMEM/F-12 and PCM medium. To this end, an appropriate number of T25  
249 flasks with the known number of cells will be set (5.5-6.5x10<sup>5</sup> cells/T25) in cDMEM/F12 medium and  
250 in PCM medium (the number of flasks depends on the number of time points; at least 6 time points  
251 should be planned). The exact number of cells applied to the culture flasks will be given in the source  
252 materials. The cells should be cultured for 10 days without changing medium and the total no. of  
253 cells should be counted everyday (with exception of weekend). In every time point (e.g. every 24 h)  
254 cells from one cell culture in cDMEM/F12 and one cell culture in PCM should be detached using  
255 Accutase and total no. of cells (live and dead) should be counted.

256 Detachment of GH3 cells should be performed as described in Section 2.3.4 with one exception:  
257 spent medium and PBS after washing should not be discarded but they should be collected in the  
258 same vial with the cells.

259 Determine density of cell suspension (total number of cells/viable+nonviable)using Trypan Blue as  
260 described in Section 2.3.6

261 Doubling time (Td) should be calculated based on total number of cells in time point (live+dead)  
262 according the following formula (ATCC, 2014):

$$263 \quad Td = (t2 - t1) \times \frac{\log(2)}{\log(q2/q1)}$$

264 where:

265 t2-t1 – incubation time in any units e.g. hours (the beginning of the incubation time - the end of the  
266 incubation time)

267 q1- the cell number at the beginning of the incubation time

268 q2- the cell number at the end of the incubation time

269 It is recommended to start the measurement on Friday and calculate the Td based on results  
270 obtained in 72- and 96-h culture of the cells when the GH3 cell growth is exponential.

## 271 **2.5. Acceptance Criteria**

272 The GH3 cells can be used for the T-screen assay when:

- 273 1. Absence of mycoplasma is confirmed
- 274 2. Absence of microbiological contamination is confirmed
- 275 3. The doubling time of the GH3 cells in cDMEM/F12 medium is  $42 \pm 5$  h
- 276 4. Cell number in PCM in 72h $\pm$ 1h and 96h $\pm$ 1h of culture should be at least 40% lower that cell  
277 number in cDMEM/F12, when determined simultaneously.

278 **3. Reference(s)**

- 279 1. Characteristics of GH3 provided by The Global Bioresource Center (ATCC)  
280 [https://www.lgcstandards-atcc.org/products/all/CCL-82.1.aspx?geo\\_country=pl#](https://www.lgcstandards-atcc.org/products/all/CCL-82.1.aspx?geo_country=pl#)  
281 2. ENV/JM/MONO(2018)19: Guidance Document on Good In Vitro Method Practices  
282 (GIVIMP, 2018)  
283 3. ATCC (2014), Animal Cell Culture Guide, ATCC.  
284 [https://www.atcc.org/~media/PDFs/Culture%20Guides/AnimCellCulture\\_Guide.ashx](https://www.atcc.org/~media/PDFs/Culture%20Guides/AnimCellCulture_Guide.ashx).  
285  
286

287 **4. Change log**

288 Standard Operating Procedure:

289 Handling, Maintenance and Quality Control of the GH3 cell line

290

ID	Version	Status	Date	List of changes in version 02 with respect to version 01:
1.	v. 01	Approved	03.03.2021	not applicable
2.	v. 02	Draft	09.12.2021	- Revising section 2.1.1, 2.1.2, 2.3.1b and 2.3.4 p.6
3.	v. 02	Final	27.12.2021	- Adding a section: Change log

291

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### **Open data from the EU**

The portal [data.europa.eu](https://data.europa.eu) provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

## The European Commission's science and knowledge service

Joint Research Centre

### JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.



**EU Science Hub**  
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