PEG/Ion Screen™

HAMPTON RESEARCH
Solutions for Crystal Growth

PEG/Ion Screen™ is a crystallization reagent kit designed to provide a rapid screening method for the crystallization of biological macromolecules in the presence of Polyethylene glycol (3,350) and 48 unique salts representing a very complete range of anions and cations frequently used in the crystallization of biological macromolecules.

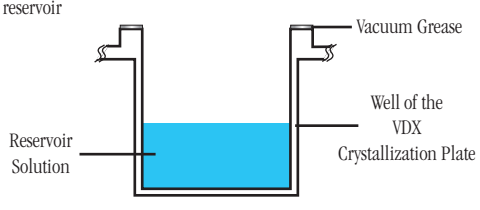
PEG/Ion Screen utilizes a monodisperse (M_r 3,300-3,400), high purity, Polyethylene glycol 3,350. The screen combines with this high purity PEG, 48 different high purity salts, comprising both anions (sulfate, nitrate, tartrate, acetate, chloride, iodide, thiocyanate, formate, citrate, phosphate, and fluoride) and cations (sodium, potassium, ammonium, lithium, magnesium, and calcium) in a relatively low concentration (0.2 M) which due to their unique pH characteristics also affords a reasonable pH screen (approximate pH range of 4 to 9). The primary screen variables are PEG, ion type, ionic strength, and pH. The screen is a straightforward, effective, and practical kit for determining preliminary crystallization conditions. Within the previous two years more than 60% of the published crystallization reports utilized polyethylene glycol as a primary crystallization reagent and in 50% of those reports the PEG was combined with a ion as a secondary crystallization reagent. PEG/Ion Screen is a crystallization screen matrix which is biased towards evaluating the most frequently reported crystallization combination within the previous two years - PEG and ionic strength. PEG/Ion Screen is also effective in determining the solubility of a macromolecule in a wide range of ions across a relatively broad pH range in the presence of polyethylene glycol.

Sample Preparation

Since it is the most frequently reported method of crystallization, the following procedure describes the use of the PEG/Ion Screen with the Hanging Drop Vapor Diffusion method. The PEG/Ion Screen is also very compatible with the Sitting Drop, Sandwich Drop, MicroBatch, and Microdialysis methods. A complete description of the Hanging, Sitting, Sandwich Drop, Dialysis and other crystallization methods are available from the Hampton Research Crystal Growth 101 Library.

1. Prepare a VDX Plate (HR3-140) for Hanging Drop Vapor Diffusion by applying a thin bead of cover slide sealant to the upper edge of each of the 24 reservoirs. One may also use a Greased VDX Plate (HR3-170). Forty-eight reservoirs are to be prepared for a complete PEG/Ion Screen. See Figure 1.

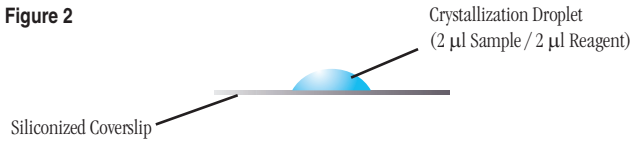
Figure 1
Cross section of a reservoir in the VDX plate.



2. Using a clean pipet tip, pipet 1 ml of PEG/Ion Screen reagent 1 into reservoir A1. Discard the pipet tip, add a new pipet tip and pipet 1 ml of PEG/Ion Screen reagent 2 into reservoir A2. Repeat the procedure for the remaining 46 PEG/Ion Screen reagents using a clean pipet tip for each reagent so as to avoid reagent contamination and carry over.

3. Pipet 2 µl of the sample to the center of a clean, siliconized 22 mm diameter circle or square cover slide. See Figure 2.

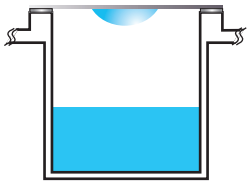
Figure 2



4. Pipet 2 µl of PEG/Ion Screen reagent 1 from reservoir A1 into the sample droplet and mix by aspirating and dispensing the droplet several times, keeping the tip in the drop during mixing to avoid foaming. See Figure 2.

5. Working quickly to minimize evaporation, invert the cover slide and droplet over reservoir A1 and seal the cover slide onto the edge of the reservoir. See Figure 3.

Figure 3
Inverted siliconized coverslip placed over the reservoir.



6. Repeat operations 3 through 5 for the remaining 47 PEG/Ion Screen reagents.

7. If the quantity of sample permits, perform the PEG/Ion Screen in duplicate and incubate one set of plates at 4°C and the second set at room temperature. Incubate and store the crystallization plates in a stable temperature environment free of vibration.

Examine The Drop

Carefully examine the drops under a stereo microscope (10 to 100x magnification) immediately after setting up the screen. Record all observations and be particularly careful to scan the focal plane for small crystals. Observe the drops once each day for the first week, then once a week there after. Records should indicate whether the drop is clear, contains precipitate, and or crystals. It is helpful to describe the drop contents using descriptive terms. Adding magnitude is also helpful. Example: 4+ yellow/brown fine precipitate, 2+ small bipyramid crystals, clear drop, 3+ needle shaped crystals in 1+ white precipitate. One may also employ a standard numerical scoring scheme (Clear = 0, Precipitate = 1, Crystal = 10, etc). Figure 4 (on page 2) shows typical examples of what one might observe in a crystallization experiment.

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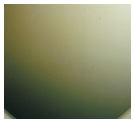
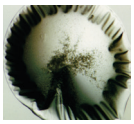
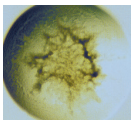
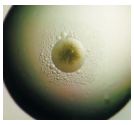
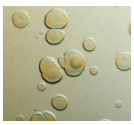
Figure 4
Typical observations in a crystallization experiment

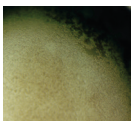

Clear Drop


Skin / Precipitate

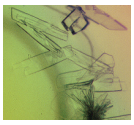

Precipitate


Precipitate / Phase

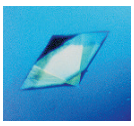

Quasi Crystals


Microcrystals


Needle Cluster


Plates


Rod Cluster


Single Crystal

Interpreting PEG/Ion Screen

Clear drops indicate that either the relative supersaturation of the sample and reagent is too low or the drop has not yet completed equilibration. If the drop remains clear after 3 to 4 weeks consider repeating the PEG/Ion Screen condition and doubling the sample concentration. If more than 33 of the 48 PEG/Ion Screen drops are clear consider doubling the sample concentration and repeating the entire screen.

Drops containing precipitate indicate that either the relative supersaturation of the sample and reagent is too high, the sample has denatured, or the sample is heterogeneous. To reduce the relative supersaturation, dilute the sample twofold and repeat the PEG/Ion Screen condition. If more than 33 of the 48 PEG/Ion Screen drops contain precipitate and no crystals are present, consider diluting the sample concentration in half and repeating the entire screen. If sample denaturation is suspect, take measures to stabilize the sample (add reducing agent, ligands, glycerol, salt, or other stabilizing agents). If the sample is impure, aggregated, or heterogeneous take measures to pursue homogeneity. It is possible to obtain crystals from precipitate so do not discard nor ignore a drop containing precipitate. If possible, examine drops containing precipitate under polarizing optics to differentiate precipitate from microcrystalline material.

If the drop contains a macromolecular crystal the relative supersaturation of the sample and reagent is good. The next step is to optimize the preliminary conditions (pH, salt type, salt concentration, precipitant type, precipitant concentration, sample concentration, temperature, additives, and other crystallization variables) which produced the crystal in order to improve crystal size and quality.

Compare the observations between the 4°C and room temperature incubation to determine the effect of temperature on sample solubility. Different results in the same drops at different temperatures indicate that sample solubility is temperature dependent and that one should include temperature as a variable in subsequent screens and optimization experiments.

Retain and observe plates until the drops are dried out. Crystal growth can occur within 15 minutes or one year.

PEG/Ion Screen Formulation

PEG/Ion Screen reagents are formulated using the highest purity chemicals, ultrapure water (18.2 Megohm-cm, 5 ppb TOC) and are sterile filtered using 0.22 micron filters into sterile containers (no preservatives added).

PEG/Ion reagents are readily reproduced using Hampton Research Optimize™ stock solutions of salts, polymers and buffers. Optimize stock reagents make reproducing PEG/Ion Screen reagents fast, convenient and easy. Dilutions can be performed directly into the crystallization plate using Optimize stock reagents.

No pH adjustments are made to PEG/Ion Screen. Reagent are combined without further titration.

PEG/Ion Screen reagents are stable at room temperature and are best if used within 12 months of receipt. To enhance reagent stability it is strongly recommended that PEG/Ion Screen be stored at 4°C or -20°C. Avoid ultraviolet light to preserve reagent stability.

If the sample contains phosphate, borate, or carbonate buffers it is possible to obtain inorganic crystals (false positives) when using PEG/Ion Screen reagents containing divalent cations such as magnesium, calcium, or zinc. To avoid false positives use phosphate, borate, or carbonate buffers at concentrations of 10 mM or less or exchange the phosphate, borate, or carbonate buffer with a more soluble buffer that does not complex with divalent cations.

References and Readings

1. Crystallization of nucleic acids and proteins, Edited by A. Ducruix and R. Giege, The Practical Approach Series, Oxford Univ. Press, 1992.
2. Current approaches to macromolecular crystallization. McPherson, A. Eur. J. Biochem. 189, 1-23, 1990.
3. Protein and Nucleic Acid Crystallization. Methods, A Companion to Methods in Enzymology, Academic Press, Volume 1, Number 1, August 1990.

Technical Support

Inquiries regarding PEG/Ion Screen reagent formulation, interpretation of screen results, optimization strategies and general inquiries regarding crystallization are welcome. Please e-mail, fax, or telephone your request to Hampton Research. Fax and e-mail Technical Support are available 24 hours a day. Telephone technical support is available 8:00 a.m. to 4:30 p.m. USA Pacific Standard Time.

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PEG/Ion Screen Fundamentals — HR2-126

How to Reproduce PEG/Ion Screen Reagents

PEG/Ion Screen reagents and optimization conditions based on PEG/Ion Screen hits can be formulated using volumetric methods and carefully prepared reagent stocks (Table 1). Note the examples below.

Example 1. To prepare 1.0 milliliter of PEG/Ion Screen reagent 1 in a crystallization plate.

Solution Composition: 0.2 M Sodium fluoride
20% w/v Polyethylene glycol 3,350

- 350 µl water[3]
- 250 µl 0.8 M Sodium fluoride
  (CAS # 7681-49-4, Catalog # HR2-645)
- 400 µl 50% w/v Polyethylene glycol 3,350
  (CAS # 25322-68-3, Catalog # HR2-527)

Make no pH adjustments. Mix well by aspirating and dispensing the solution multiple times.

Example 2. To prepare 1.0 milliliter of PEG/Ion Screen reagent 20.

Solution Composition: 0.2 M Magnesium formate dihydrate
20% w/v Polyethylene glycol 3,350

- 400 µl water[3]
- 200 µl Magnesium formate dihydrate
  (CAS # 557-39-1, Catalog # HR2-537)
- 400 µl 50% w/v Polyethylene glycol 3,350
  (CAS # 25322-68-3, Catalog # HR2-527)

Make no pH adjustments. Mix well.

Example 3. To prepare 10 milliliters of PEG/Ion Screen reagent 5.

Solution Composition: 0.2 M Magnesium chloride hexahydrate
20% w/v Polyethylene glycol 3,350

- 5.0 ml water[3]
- 1.0 ml 2.0 M Magnesium chloride hexahydrate
  (CAS # 7791-18-6, Catalog # HR2-559)
- 400 ml 50% w/v Polyethylene glycol 3,350
  (CAS # 25322-68-3, Catalog # HR2-527)

Make no pH adjustments. Mix well.

[3] ASTM Type II (laboratory grade) or Type III (analytical grade) water.

Formulation Notes for PEG/Ion Screen Reagents

1. No additional pH adjustment is made to any reagent after formulation. Use the buffers in Table 1 to reproduce a PEG/Ion Screen reagent.
2. All Optimize solutions and screen reagents are sterile filtered using 0.22 µm filters into sterile containers.
3. Add water first as this will help maintain the solubility of subsequently added reagents.
4. When formulating reagents using a pipet, add the largest volume last (except water). Use this larger volume setting to aspirate and dispense the reagent until the solution is mixed.
5. When formulating reagents using a pipet, use a clean, sterile pipet tip for each reagent added to the solution.
6. Use Optimize, StockOptions pH, and StockOptions pH buffer kits from Hampton Research to systematically vary the pH as a crystallization variable.

pH as a Crystallization Variable

Optimize™ buffer stocks are supplied as a 100 milliliters sterile filtered solution. The pH can be adjusted to the indicated pH range using either HCl or NaOH and the supplied titration tables.

StockOptions™ buffer kits contain 10 milliliters each of ready to pipet buffers, titrated in 0.1 pH increments over the indicated pH range. The number of reagents offered in a StockOptions buffer kit depends upon the pH range of the buffer. The broader the pH range, the more buffers in the kit.

Online Information

Visit www.hamptonresearch.com and enter one of the following:

- Reagent Catalog Number
- Kit Catalog Number
- CAS Number
- Reagent Name

To obtain reagent specifications, pH titration tables, user guides, certificates of analysis, material safety data sheets (MSDS), and any other additional information.

MakeTray™

MakeTray is a free, web based program at www.hamptonresearch.com which generates both a pipetting worksheet and a reagent formulation document for crystallization set ups. MakeTray allows one to enter general information about the sample and experiment, which is then printed on the pipet worksheet and the reagent formulation document. The plate size can be customized for any number of wells, so MakeTray works for: 24, 48, and 96 well plates. MakeTray is especially useful for the design and formulation of crystal optimization experiments.

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Table 1. Recommended reagents for the formulation of PEG/Ion Screen and optimization reagents.

Each of these reagents are available as an Optimize™ crystallization grade reagent from Hampton Research. Table 1 provides the common chemical name, the Hampton Research catalog number, supplied stock concentration, the supplied volume, and the CAS number for each reagent. For more information on a specific Optimize reagent, go to www.hamptonresearch.com. Using Search, enter either the catalog number, CAS number, or chemical name to obtain additional information for the Optimize reagent, including a Certificate of Analysis and MSDS (where applicable).

Salts	Hampton Research Catalog #	Supplied [Stock]	Supplied Volume	CAS #
Ammonium acetate	HR2-565	1.0 M	100 ml	631-61-8
	HR2-799	8.0 M	200 ml	631-61-8
Ammonium chloride	HR2-691	5.0 M	200 ml	12125-02-9
Ammonium citrate dibasic	HR2-685	2.5 M	200 ml	3012-65-5
Ammonium fluoride	HR2-689	10.0 M	200 ml	12125-01-8
Ammonium formate	HR2-659	10.0 M	200 ml	540-69-2
Ammonium iodide	N/A [4]	N/A	N/A	12027-06-4
Ammonium nitrate	HR2-665	10.0 M	200 ml	6484-52-2
Ammonium phosphate dibasic	HR2-629	3.5 M	200 ml	7783-28-0
Ammonium phosphate monobasic	HR2-555	2.5 M	200 ml	7722-76-1
Ammonium sulfate	HR2-541	3.5 M	200 ml	7783-20-2
Ammonium tartrate dibasic	HR2-679	2.0 M	200 ml	3164-29-2
Calcium acetate hydrate	HR2-567	1.0 M	100 ml	114460-21-8
Calcium chloride dihydrate	HR2-557	2.0 M	100 ml	10035-04-8
Lithium acetate dihydrate	HR2-669	5.0 M	200 ml	6108-17-4
Lithium chloride	HR2-631	10.0 M	200 ml	7447-41-8
Lithium citrate tribasic tetrahydrate	HR2-681	1.5 M	200 ml	6080-58-6
Lithium nitrate	HR2-697	8.0 M	200 ml	7790-69-4
Lithium sulfate monohydrate	HR2-545	2.0 M	200 ml	10102-25-7
Magnesium acetate tetrahydrate	HR2-561	1.0 M	100 ml	16674-78-5
Magnesium chloride hexahydrate	HR2-559	2.0 M	100 ml	7791-18-6
	HR2-803	5.0 M	200 ml	7791-18-6
Magnesium formate dihydrate	HR2-537	1.0 M	200 ml	557-39-1
Magnesium nitrate hexahydrate	HR2-657	3.0 M	200 ml	13446-18-9
Magnesium sulfate heptahydrate	HR2-821	2.0 M	100 ml	10034-99-8
Potassium acetate	HR2-671	5.0 M	200 ml	127-08-2
Potassium chloride	HR2-649	4.0 M	200 ml	7447-40-7
Potassium citrate tribasic monohydrate	HR2-683	2.5 M	200 ml	6100-05-6

[4] Prepare fresh solution on day of use.

(Continued on page 3)

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Table 1 (Continued). **Recommended reagents for the formulation of PEG/Ion Screen and optimization reagents.**

Salts	Hampton Research Catalog #	Supplied [Stock]	Supplied Volume	CAS #
Potassium fluoride	HR2-647	6.0 M	100 ml	7789-23-3
Potassium formate	HR2-667	14.0 M	200 ml	590-29-4
Potassium iodide	N/A [4]	N/A	N/A	7681-11-0
Potassium nitrate	HR2-663	2.0 M	200 ml	7757-79-1
Potassium phosphate dibasic	HR2-635	4.0 M	200 ml	7758-11-4
Potassium phosphate monobasic	HR2-553	1.5 M	200 ml	7778-77-0
Potassium sodium tartrate tetrahydrate	HR2-539	1.5 M	200 ml	6381-59-5
Potassium sulfate	HR2-675	0.5 M	200 ml	7778-80-5
Potassium thiocyanate	HR2-695	8.0 M	200 ml	333-20-0
Sodium acetate trihydrate	HR2-543	3.0 M	200 ml	6131-90-4
Sodium chloride	HR2-637	5.0 M	200 ml	7647-14-5
Sodium citrate tribasic dihydrate	HR2-549	1.6 M	200 ml	6132-04-3
Sodium fluoride	HR2-645	0.8 M	100 ml	7681-49-4
Sodium formate	HR2-547	7.0 M	200 ml	141-53-7
Sodium iodide	N/A [4]	N/A	N/A	7681-82-5
Sodium nitrate	HR2-661	7.0 M	200 ml	7631-99-4
Sodium phosphate dibasic dihydrate	HR2-639	1.0 M	200 ml	10028-24-7
Sodium phosphate monobasic monohydrate	HR2-551	4.0 M	200 ml	10049-21-5
Sodium sulfate decahydrate	HR2-673	1.0 M	200 ml	7727-73-3
Sodium tartrate dibasic dihydrate	HR2-677	1.5 M	200 ml	6106-24-7
Sodium thiocyanate	HR2-693	8.0 M	200 ml	540-72-7
Zinc acetate dihydrate	HR2-563	1.0 M	100 ml	5970-45-6
[4] Prepare fresh solution on day of use.				
Polymers	**Hampton Research Catalog #**	**Supplied [Stock]**	**Supplied Volume**	**CAS #**
Polyethylene glycol 3,350	HR2-527	50 % w/v	200 ml	25322-68-3

Technical Support

Inquiries regarding PEG/Ion Screen Fundamentals, interpretation of screen results, optimization strategies and general inquiries regarding crystallization are welcome. Please e-mail, fax, or telephone your request to Hampton Research. Fax and e-mail Technical Support are available 24 hours a day. Telephone technical support is available 8:00 a.m. to 4:30 p.m. USA Pacific Standard Time.

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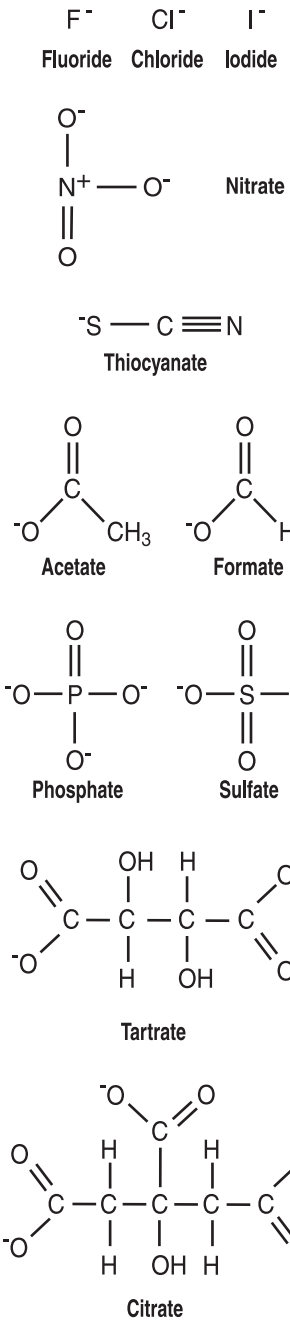
Tube #	Salt	Tube #	Polymer	Tube #	pH ◊
1.	0.2 M Sodium fluoride	1.	20% w/v Polyethylene glycol 3,350	1.	7.3
2.	0.2 M Potassium fluoride	2.	20% w/v Polyethylene glycol 3,350	2.	7.3
3.	0.2 M Ammonium fluoride	3.	20% w/v Polyethylene glycol 3,350	3.	6.2
4.	0.2 M Lithium chloride	4.	20% w/v Polyethylene glycol 3,350	4.	6.8
5.	0.2 M Magnesium chloride hexahydrate	5.	20% w/v Polyethylene glycol 3,350	5.	5.9
6.	0.2 M Sodium chloride	6.	20% w/v Polyethylene glycol 3,350	6.	6.9
7.	0.2 M Calcium chloride dihydrate	7.	20% w/v Polyethylene glycol 3,350	7.	5.1
8.	0.2 M Potassium chloride	8.	20% w/v Polyethylene glycol 3,350	8.	7.0
9.	0.2 M Ammonium chloride	9.	20% w/v Polyethylene glycol 3,350	9.	6.3
10.	0.2 M Sodium iodide	10.	20% w/v Polyethylene glycol 3,350	10.	7.0
11.	0.2 M Potassium iodide	11.	20% w/v Polyethylene glycol 3,350	11.	7.0
12.	0.2 M Ammonium iodide	12.	20% w/v Polyethylene glycol 3,350	12.	6.2
13.	0.2 M Sodium thiocyanate	13.	20% w/v Polyethylene glycol 3,350	13.	6.9
14.	0.2 M Potassium thiocyanate	14.	20% w/v Polyethylene glycol 3,350	14.	7.0
15.	0.2 M Lithium nitrate	15.	20% w/v Polyethylene glycol 3,350	15.	7.1
16.	0.2 M Magnesium nitrate hexahydrate	16.	20% w/v Polyethylene glycol 3,350	16.	5.9
17.	0.2 M Sodium nitrate	17.	20% w/v Polyethylene glycol 3,350	17.	6.8
18.	0.2 M Potassium nitrate	18.	20% w/v Polyethylene glycol 3,350	18.	6.8
19.	0.2 M Ammonium nitrate	19.	20% w/v Polyethylene glycol 3,350	19.	6.2
20.	0.2 M Magnesium formate dihydrate	20.	20% w/v Polyethylene glycol 3,350	20.	7.0
21.	0.2 M Sodium formate	21.	20% w/v Polyethylene glycol 3,350	21.	7.2
22.	0.2 M Potassium formate	22.	20% w/v Polyethylene glycol 3,350	22.	7.3
23.	0.2 M Ammonium formate	23.	20% w/v Polyethylene glycol 3,350	23.	6.6
24.	0.2 M Lithium acetate dihydrate	24.	20% w/v Polyethylene glycol 3,350	24.	7.9
25.	0.2 M Magnesium acetate tetrahydrate	25.	20% w/v Polyethylene glycol 3,350	25.	7.9
26.	0.2 M Zinc acetate dihydrate	26.	20% w/v Polyethylene glycol 3,350	26.	6.4
27.	0.2 M Sodium acetate trihydrate	27.	20% w/v Polyethylene glycol 3,350	27.	8.0
28.	0.2 M Calcium acetate hydrate	28.	20% w/v Polyethylene glycol 3,350	28.	7.5
29.	0.2 M Potassium acetate	29.	20% w/v Polyethylene glycol 3,350	29.	8.1
30.	0.2 M Ammonium acetate	30.	20% w/v Polyethylene glycol 3,350	30.	7.1
31.	0.2 M Lithium sulfate monohydrate	31.	20% w/v Polyethylene glycol 3,350	31.	6.0
32.	0.2 M Magnesium sulfate heptahydrate	32.	20% w/v Polyethylene glycol 3,350	32.	6.0
33.	0.2 M Sodium sulfate decahydrate	33.	20% w/v Polyethylene glycol 3,350	33.	6.7
34.	0.2 M Potassium sulfate	34.	20% w/v Polyethylene glycol 3,350	34.	6.8
35.	0.2 M Ammonium sulfate	35.	20% w/v Polyethylene glycol 3,350	35.	6.0
36.	0.2 M Sodium tartrate dibasic dihydrate	36.	20% w/v Polyethylene glycol 3,350	36.	7.3
37.	0.2 M Potassium sodium tartrate tetrahydrate	37.	20% w/v Polyethylene glycol 3,350	37.	7.4
38.	0.2 M Ammonium tartrate dibasic	38.	20% w/v Polyethylene glycol 3,350	38.	6.6
39.	0.2 M Sodium phosphate monobasic monohydrate	39.	20% w/v Polyethylene glycol 3,350	39.	4.7
40.	0.2 M Sodium phosphate dibasic dihydrate	40.	20% w/v Polyethylene glycol 3,350	40.	9.1
41.	0.2 M Potassium phosphate monobasic	41.	20% w/v Polyethylene glycol 3,350	41.	4.8
42.	0.2 M Potassium phosphate dibasic	42.	20% w/v Polyethylene glycol 3,350	42.	9.2
43.	0.2 M Ammonium phosphate monobasic	43.	20% w/v Polyethylene glycol 3,350	43.	4.6
44.	0.2 M Ammonium phosphate dibasic	44.	20% w/v Polyethylene glycol 3,350	44.	8.0
45.	0.2 M Lithium citrate tribasic tetrahydrate	45.	20% w/v Polyethylene glycol 3,350	45.	8.4
46.	0.2 M Sodium citrate tribasic dihydrate	46.	20% w/v Polyethylene glycol 3,350	46.	8.3
47.	0.2 M Potassium citrate tribasic monohydrate	47.	20% w/v Polyethylene glycol 3,350	47.	8.3
48.	0.2 M Ammonium citrate dibasic	48.	20% w/v Polyethylene glycol 3,350	48.	5.1



◊ Measured pH at 25 ° C

PEG/Ion Screen contains forty-eight unique reagents. To determine the formulation of each reagent, simply read across the page.

34 Journey
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HAMPTON RESEARCH
Solutions for Crystal Growth

Sample: _____ Sample Concentration: _____

Sample Buffer: _____ Date: _____

Reservoir Volume: _____ Temperature: _____

Drop Volume: Total _____ µl Sample _____ µl Reservoir _____ µl Additive _____ µl

1 Clear Drop
2 Phase Separation
3 Regular Granular Precipitate
4 Birefringent Precipitate or Microcrystals
5 Posettes or Spherulites
6 Needles (1D Growth)
7 Plates (2D Growth)
8 Single Crystals (3D Growth < 0.2 mm)
9 Single Crystals (3D Growth > 0.2 mm)

PEG/Ion Screen™ - HR2-126 Scoring Sheet	Date:	Date:	Date:	Date:
1. 0.2 M Sodium fluoride, 20% w/v Polyethylene glycol 3,350				
2. 0.2 M Potassium fluoride, 20% w/v Polyethylene glycol 3,350				
3. 0.2 M Ammonium fluoride, 20% w/v Polyethylene glycol 3,350				
4. 0.2 M Lithium chloride, 20% w/v Polyethylene glycol 3,350				
5. 0.2 M Magnesium chloride hexahydrate, 20% w/v Polyethylene glycol 3,350				
6. 0.2 M Sodium chloride, 20% w/v Polyethylene glycol 3,350				
7. 0.2 M Calcium chloride dihydrate, 20% w/v Polyethylene glycol 3,350				
8. 0.2 M Potassium chloride, 20% w/v Polyethylene glycol 3,350				
9. 0.2 M Ammonium chloride, 20% w/v Polyethylene glycol 3,350				
10. 0.2 M Sodium iodide, 20% w/v Polyethylene glycol 3,350				
11. 0.2 M Potassium iodide, 20% w/v Polyethylene glycol 3,350				
12. 0.2 M Ammonium iodide, 20% w/v Polyethylene glycol 3,350				
13. 0.2 M Sodium thiocyanate, 20% w/v Polyethylene glycol 3,350				
14. 0.2 M Potassium thiocyanate, 20% w/v Polyethylene glycol 3,350				
15. 0.2 M Lithium nitrate, 20% w/v Polyethylene glycol 3,350				
16. 0.2 M Magnesium nitrate hexahydrate, 20% w/v Polyethylene glycol 3,350				
17. 0.2 M Sodium nitrate, 20% w/v Polyethylene glycol 3,350				
18. 0.2 M Potassium nitrate, 20% w/v Polyethylene glycol 3,350				
19. 0.2 M Ammonium nitrate, 20% w/v Polyethylene glycol 3,350				
20. 0.2 M Magnesium formate dihydrate, 20% w/v Polyethylene glycol 3,350				
21. 0.2 M Sodium formate, 20% w/v Polyethylene glycol 3,350				
22. 0.2 M Potassium formate, 20% w/v Polyethylene glycol 3,350				
23. 0.2 M Ammonium formate, 20% w/v Polyethylene glycol 3,350				
24. 0.2 M Lithium acetate dihydrate, 20% w/v Polyethylene glycol 3,350				
25. 0.2 M Magnesium acetate tetrahydrate, 20% w/v Polyethylene glycol 3,350				
26. 0.2 M Zinc acetate dihydrate, 20% w/v Polyethylene glycol 3,350				
27. 0.2 M Sodium acetate trihydrate, 20% w/v Polyethylene glycol 3,350				
28. 0.2 M Calcium acetate hydrate, 20% w/v Polyethylene glycol 3,350				
29. 0.2 M Potassium acetate, 20% w/v Polyethylene glycol 3,350				
30. 0.2 M Ammonium acetate, 20% w/v Polyethylene glycol 3,350				
31. 0.2 M Lithium sulfate monohydrate, 20% w/v Polyethylene glycol 3,350				
32. 0.2 M Magnesium sulfate heptahydrate, 20% w/v Polyethylene glycol 3,350				
33. 0.2 M Sodium sulfate decahydrate, 20% w/v Polyethylene glycol 3,350				
34. 0.2 M Potassium sulfate, 20% w/v Polyethylene glycol 3,350				
35. 0.2 M Ammonium sulfate, 20% w/v Polyethylene glycol 3,350				
36. 0.2 M Sodium tartrate dibasic dihydrate, 20% w/v Polyethylene glycol 3,350				
37. 0.2 M Potassium sodium tartrate tetrahydrate, 20% w/v Polyethylene glycol 3,350				
38. 0.2 M Ammonium tartrate dibasic, 20% w/v Polyethylene glycol 3,350				
39. 0.2 M Sodium phosphate monobasic monohydrate, 20% w/v Polyethylene glycol 3,350				
40. 0.2 M Sodium phosphate dibasic dihydrate, 20% w/v Polyethylene glycol 3,350				
41. 0.2 M Potassium phosphate monobasic, 20% w/v Polyethylene glycol 3,350				
42. 0.2 M Potassium phosphate dibasic, 20% w/v Polyethylene glycol 3,350				
43. 0.2 M Ammonium phosphate monobasic, 20% w/v Polyethylene glycol 3,350				
44. 0.2 M Ammonium phosphate dibasic, 20% w/v Polyethylene glycol 3,350				
45. 0.2 M Lithium citrate tribasic tetrahydrate, 20% w/v Polyethylene glycol 3,350				
46. 0.2 M Sodium citrate tribasic dihydrate, 20% w/v Polyethylene glycol 3,350				
47. 0.2 M Potassium citrate tribasic monohydrate, 20% w/v Polyethylene glycol 3,350				
48. 0.2 M Ammonium citrate dibasic, 20% w/v Polyethylene glycol 3,350				

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