



**One-Day (24-28 h) Standardized Laboratory Protocol for Molecular Subtyping of
Yersinia pestis
by Pulsed Field Gel Electrophoresis (PFGE)**

PREPARATION OF PFGE PLUGS FROM AGAR CULTURES

BIOSAFETY WARNING: *Yersinia pestis* is a human pathogen and can cause serious disease. Check with your institution's select agent policy before handling these isolates. Biosafety Level 2 or 3 (depending on your institution) are required when handling this agent. Always use extreme caution when transferring and handling strains in general. Work in a biological safety cabinet when handling large amounts of cells. Disinfect or dispose of all plasticware and glassware that come in contact with the cultures in a safe manner.

Please read all instructions carefully before starting protocol. Treat all plasticware, glassware, pipets, spatulas, etc. that come in contact with the cell suspensions or plugs as contaminated materials and dispose of, or disinfect according to the guidelines of your institution. Disinfect reusable plug molds before they are washed; the disposable plug molds, including the tape and the tab that is used to push the plugs out of the wells, are also contaminated and should be disinfected with 10% bleach for at least 30 minutes if they will be washed and reused.

Day 0

Streak an isolated colony from test cultures to a Blood agar plate fortified with 6% sheep blood (or comparable media) for confluent growth. Incubate cultures at 28°C (room temp) or 37°C for 48 h. If additional diagnostic tests for the presence of F1 antigen are to be done on the isolate, cultures need to be incubated at 37°C for the F1 antigen to be expressed.

Day 1

1. **Turn on shaker water bath (54°C), stationary water baths (55-60°C) and spectrophotometer** (or equivalent instrument such as the Dade Microscan Turbidity meter or bioMérieux Vitek colorimeter).
2. Prepare **TE Buffer (10 mM Tris:1 mM EDTA, pH 8.0)**¹ as follows:

10 ml of 1 M Tris, pH 8.0
2 ml of 0.5 M EDTA, pH 8.0
Dilute to 1000 ml with sterile Ultrapure (Reagent Grade Type 1) water

Note: The TE Buffer is used to make the plug agarose and also to wash lysed PFGE plugs.

¹Additional information is found in the PulseNet PFGE Manual.

3. Prepare 1% SeaKem Gold:1% SDS agarose in **TE Buffer (10 mM Tris:1 mM EDTA, pH 8.0)** for PFGE plugs as follows:
 - a. Weigh 0.50 g (or 0.25 g) SeaKem Gold (SKG) into 250 ml screw-cap flask.
 - b. Add 47.0 ml (or 23.5 ml) TE Buffer; swirl gently to disperse agarose.
 - c. Remove cap, cover loosely with clear film, and microwave for 30-sec; mix gently and repeat for 10-sec intervals until agarose is completely dissolved. Place flask in 55-60°C water bath for 5 minutes before adding SDS.
 - d. Add 2.5 ml (or 1.25 ml) of 20% SDS (pre-heated to 55°C) and mix well.
 - e. Recap flask and return to 55- 60°C water bath until ready to use.

SAFETY WARNING: Use heat-resistant gloves when handling hot flasks after microwaving.

Note: SeaKem Gold agarose works well for making PFGE plugs because it provides added strength to the plugs that are cast in reusable plug molds, minimizing breakage of plugs during the lysis and washing steps. The time and temperature needed to completely dissolve the agarose is dependent on the specifications of the microwave used, and will have to be determined empirically in each laboratory.

4. Label small tubes (12-mm x 75-mm Falcon tubes or equivalent) with culture numbers.
5. Prepare **Cell Suspension Buffer (100 mM Tris:100 mM EDTA, pH 8.0)** as follows:

10 ml of 1 M Tris, pH 8.0

20 ml of 0.5 M EDTA, pH 8.0

Dilute to 100 ml with sterile Ultrapure (Reagent Grade Type 1) water

6. Transfer ≈2 ml of **Cell Suspension Buffer (CSB)** to small labeled tubes. Use a sterile polyester-fiber or cotton swab that has been moistened with sterile CSB to remove some of the growth from agar plate; suspend cells in CSB by spinning swab gently so cells will be evenly dispersed and formation of aerosols is minimized.

Note: The minimum volume of the cell suspension needed will depend on size of the cuvettes or tubes used to measure the cell concentration and are dependent on the manufacturer's specifications for the spectrophotometer, turbidity meter, or colorimeter. Keep suspensions on ice if you have more than 6 cultures to process or refrigerate cell suspensions if you cannot adjust their concentration immediately.

7. Adjust concentration of cell suspensions to one of values given below by diluting with sterile CSB or by adding additional cells.
 - a. Spectrophotometer: 610 nm wavelength, absorbance (Optical Density) of **1.35** (range of 1.3-1.4)
 - b. Dade Microscan Turbidity Meter: **0.48 - 0.53** (measured in Falcon 2054 tubes)
0.68 - 0.72 (measured in Falcon 2057 tubes)
 - c. bioMérieux Vitek colorimeter: **20%** transmittance (measured in Falcon 2054 tubes)

Note: Cell suspensions need to be at room temperature when concentration is checked. The values in Steps 7a. and 7b. give satisfactory results at CDC; if different instruments or tubes are used, each laboratory may need to establish the concentration needed for satisfactory results.

CASTING PLUGS

Label wells of PFGE plug molds with culture number. When reusable plug molds are used, put strip of tape on lower part of reusable plug mold before labeling wells.

Note 1: Unused plug agarose can be kept at room temperature and reused 1-2 times. Microwave on low-medium power for 10 -15 sec and mix; repeat for 5 -10 sec intervals until agarose is completely melted. This agarose melts rapidly!

Note 2: Proteinase K solutions (20 mg/ml) are available commercially, or a stock solution of Proteinase K can be prepared from the powder in sterile Ultrapure (Reagent Grade Type 1) water, aliquoted in 300-500 µl amounts, and kept frozen. Just before use, thaw appropriate number of vials needed for the samples; keep Proteinase K solutions on ice. Discard any thawed Proteinase K stock solution that was prepared from powder by the user at end of work day. Store commercially prepared Proteinase K solutions according to directions provided by the supplier.

1. Transfer 400 µl (0.4 ml) adjusted cell suspensions to labeled 1.5-ml microcentrifuge tubes. If cell suspensions are at room temperature, agarose can be added directly without pre-warming cell suspensions. If cell suspensions are cold, place tubes containing cell suspensions in plastic holders (floats); incubate in a 37°C water bath for a few minutes.
2. Add 20 µl of Proteinase K (20 mg/ml stock) to each tube and mix gently with pipet tip. (200 µl are needed for 10 cell suspensions.)
3. Add 400 µl (0.4 ml) melted 1% SeaKem Gold:1% SDS agarose to the 0.4-ml cell suspension; mix by gently pipetting mixture up and down a few times. Maintain temperature of melted agarose by keeping flask in beaker of warm water (55-60°C).
4. Immediately, dispense part of mixture into appropriate well(s) of disposable plug mold.* Do not allow bubbles to form. Two plugs of each sample can be made from these amounts of cell suspension and agarose. Allow plugs to solidify at room temperature for 10-15 min. They can also be placed in the refrigerator (4°C) for 5 minutes.

* Disposable plug molds are recommended for BSL-3 work as the plug molds can be discarded easily.

Note: If disposable plug molds are used for making plugs with 1% SeaKem Gold:1% SDS agarose, use 200 µl cell suspension, 10 µl of Proteinase K (20 mg/ml stock) and 200 µl of agarose; up to 4 plugs can be made from these amounts of cell suspension and agarose.

LYSIS OF CELLS IN AGAROSE PLUGS

Note: Two plugs (reusable plug molds) or 3 - 4 plugs (disposable plug molds) of the same strain can be lysed in the same 50-ml tube.

1. Label 50-ml polypropylene screw-cap or 50-ml Oak Ridge tubes with culture numbers.
2. Prepare **Cell Lysis Buffer (50 mM Tris:50 mM EDTA, pH 8.0 + 1% Sarcosyl)** as follows:
 - 25 ml of 1 M Tris, pH 8.0
 - 50 ml of 0.5 M EDTA, pH 8.0
 - 50 ml of 10 % Sarcosyl (N-Lauroylsarcosine, Sodium salt)²
 - Dilute to 500 ml with sterile Ultrapure (Reagent Grade Type 1) water
3. Calculate the total volume of **Cell Lysis/Proteinase K Buffer** needed as follows:
 - a. 5 ml **Cell Lysis Buffer (50 mM Tris:50 mM EDTA, pH 8.0 + 1% Sarcosyl)** is needed per tube (e. g., 5 ml x 10 tubes = 50 ml).
 - b. 25 µl **Proteinase K** stock solution (20 mg/ml) is needed per tube of the cell lysis buffer (e. g., 25 µl x 10 tubes = 250 µl).
 - c. Measure correct volumes into appropriate size test tube or flask and mix well.

Note: The final concentration of Proteinase K in the lysis buffer is 0.1 mg/ml, and is different from the concentration that was added to the cell suspension (0.5 mg/ml).

4. Add 5 ml of Proteinase K/Cell Lysis Buffer to each labeled 50 ml tube.
5. Trim excess agarose from top of plugs with scalpel or razor blade (optional). Open reusable plug mold and transfer plugs from mold with a 6-mm wide spatula to appropriately labeled tube. If disposable plug molds are used, remove white tape from bottom of mold and push out plug(s) into appropriately labeled tube. Be sure plugs are under buffer and not on side of tube.

Note: The excess agarose, plug mold, spatula, etc. are contaminated. Discard or disinfect appropriately.

6. **Remove tape from reusable mold.** Place both sections of plug mold, spatulas, and scalpel in 70% isopropanol (IPA) or other suitable disinfectant. **Soak them for 15 minutes before washing them.** Discard disposable plug molds or disinfect them in 10% bleach for 30-60 minutes if they will be washed and reused.
7. Place tubes in rack and incubate in a 54°C shaker water bath for 2 h with constant and vigorous agitation (175-200 rpm). Be sure water level in water bath is above level of lysis buffer in tubes.
8. Pre-heat enough sterile Ultrapure (Reagent Grade Type 1) water to 50°C so that plugs can be washed two times with 10-15 ml water (200-250 ml for 10 tubes).

²The N-Lauroylsarcosine, Sodium salt can be added directly to the other ingredients and allowed to dissolve.

WASHING OF AGAROSE PLUGS AFTER CELL LYSIS

Lower the temperature of the shaker water bath to 50°C.

1. Remove tubes from water bath, and carefully pour off lysis buffer into an appropriate discard container; plugs can be held in tubes with a screened cap or spatula.

Note: It is important to remove all of the liquid during this and subsequent wash steps by touching edge of tube or screened cap on an absorbent paper towel.

2. Add at 10-15 ml sterile Ultrapure (Reagent Grade Type 1) water that has been pre-heated to 50°C to each tube and shake the tubes vigorously in a 50°C water bath for 10-15 min.
3. Pour off water from the plugs and repeat wash step with pre-heated water (Step 2) one more time.
 - a. Pre-heat enough sterile **TE Buffer (10 mM Tris:1 mM EDTA, pH 8.0)** in a 50°C water bath so that plugs can be washed four times with 10-15 ml TE (300-350 ml for 10 tubes) after beginning last water wash.
4. Pour off water, add 10-15 ml pre-heated (50°C) sterile TE Buffer, and shake the tubes vigorously in 50°C water bath for 10-15 min.
5. Pour off TE and repeat wash step with pre-heated TE three more times.
6. Decant last wash and add 5-10 ml sterile TE. Continue with step 1 in "Restriction Digestion" section or store plugs in TE Buffer at 4°C until needed. Plugs can be transferred to smaller tubes for storage.

Note: If restriction digestion is to be done the same day, complete Steps 1-3 of next section (**RESTRICTION DIGESTION OF DNA IN AGAROSE PLUGS WITH *AscI* & *XbaI***) during last TE wash step for optimal use of time.

RESTRICTION DIGESTION OF DNA IN AGAROSE PLUGS WITH *AscI* & *XbaI*

Note: A small slice of the plug or the entire plug (made in disposable plug molds) can be digested with the restriction enzyme. Restriction digestion of a small slice of the plug is recommended because less enzyme is required and other slices of the plug can be subjected to restriction analysis with other enzymes, such as *FseI*, etc. This is important when the PFGE patterns obtained with the primary enzyme from two or more isolates are indistinguishable, and confirmation is needed to determine that the PFGE patterns of these isolates are also indistinguishable with additional enzymes.

1. Label 1.5-ml microcentrifuge tubes with *Yersinia pestis* culture numbers; label 3 (10-well gel) or 4 (15-well gel) tubes for *Salmonella* ser. Braenderup H9812 standards.
 - a. **Optional Pre-Restriction Incubation Step:** Dilute 10X H buffer (Roche Molecular Biochemicals or equivalent) and 10X Buffer 4 (New England Biolabs or equivalent) 1:10 with sterile Ultrapure (Reagent Grade Type 1) water according to the following table.

Reagent	µl/Plug Slice	µl/10 Plug Slices	µl/15 Plug Slices
Sterile Reagent Grade Water	180 µl	1800 µl	2700 µl
H Buffer	20 µl	200 µl	300 µl
Total Volume	200 µl	2000 µl	3000 µl

Reagent	µl/Plug Slice	µl/10 Plug Slices	µl/15 Plug Slices
Sterile Reagent Grade Water	180 µl	1800 µl	2700 µl
Buffer 4	20 µl	200 µl	300 µl
Total Volume	200 µl	2000 µl	3000 µl

- b. Add 200 µl diluted H buffer (1X) to *S. ser. Braenderup* labeled 1.5-ml microcentrifuge tubes.
- c. Add 200 ul diluted buffer 4 (1X) to *Yersinia pestis* labeled 1.5 ml microcentriufge tubes.
- d. Carefully remove plug from TE with spatula and place in a sterile disposable Petri dish or on large glass slide.
- e. Cut a 2.0- to 2.5-mm-wide slice from test samples with a single edge razor blade (or scalpel, cover slip, etc.) and transfer to tube containing diluted buffer 4. Be sure plug slice is under buffer. Replace rest of plug in original tube that contains 5 ml TE buffer. Store at 4°C.

Note: The shape and size of the plug slice that is cut will depend on the size of the comb teeth that are used for casting the gel. PulseNet recommends that the combs with larger teeth (10-mm-wide teeth) be used to cast the gels because computer analysis of the gel lanes is more accurate and less tedious than analysis of gel lanes cast with combs with the smaller teeth (5.5-mm). The number of slices that can be cut from the plugs will depend on the skill and experience of the operator, integrity of the plug, and whether the slices are cut vertically or horizontally (plugs made in disposable molds).

- f. Cut three or four 2.0-mm-wide slices from plug of the *S. ser. Braenderup* H9812 standard and transfer to tubes with diluted H buffer. Be sure plug slices are under buffer. Replace rest of plug in original tube that contains 5 ml TE buffer. Store at 4°C.
- g. Incubate sample and control plug slices in 37°C water bath for 5-10 min or at room temperature for 10-15 min.

- h. After incubation, remove buffer from plug slice using a pipet fitted with 200-250 μl tip all the way to bottom of tube and aspirate buffer. Be careful not to cut plug slice with pipet tip and that plug slice is not discarded with pipet tip.
2. Dilute 10X H buffer 1:10 with sterile Ultrapure (Reagent Grade Type 1) water and add restriction enzyme³ (50 U/sample for *S. ser.* Braenderup and 40U/sample for *Y. pestis*) according to the following table. Mix in the same tube that was used for the diluted H buffer.

Reagent	$\mu\text{l}/\text{Plug Slice}$	MI/10 Plug Slices	$\mu\text{l}/15 \text{ Plug Slices}$
Sterile Reagent Grade Water	175 μl	1750 μl	2625 μl
H Buffer	20 μl	200 μl	300 μl
Enzyme <i>XbaI</i> (10 U/μl)	5 μl	50 μl	75 μl
Total Volume	200 μl	2000 μl	3000 μl

Reagent	$\mu\text{l}/\text{Plug Slice}$	MI/10 Plug Slices	$\mu\text{l}/15 \text{ Plug Slices}$
Sterile Reagent Grade Water	174 μl	1740 μl	2610 μl
Buffer 4	20 μl	200 μl	300 μl
Bovine Serum Albumin (BSA)	2 μl	20 μl	30 μl
Enzyme <i>AscI</i> (10 U/μl)	4 μl	40 μl	60 μl
Total Volume	200 μl	2000 μl	3000 μl

Note: Keep vial of restriction enzyme on ice or in insulated storage box (-20°C) at all times.

- Add 200 μl restriction enzyme mixture to each tube. Close tube and mix by tapping gently; be sure plug slices are under enzyme mixture.
- Incubate sample and control plug slices in 37°C water bath for 4 h.
- If plug slices will be loaded into the wells, continue with Steps 1-4 of the next section (**CASTING AGAROSE GEL**) approximately 1 h before restriction digest reaction is finished so the gel can solidify for at least 30 minutes before loading the restricted PFGE plugs.

CASTING AGAROSE GEL

A. Loading Restricted Plug Slices on the Comb:

1. **Confirm that water bath is equilibrated to 55- 60°C.**
2. Make volume of 0.5X Tris-Borate EDTA Buffer (TBE) that is needed for both the gel and electrophoresis running buffer according to one of the following tables.

5X TBE:

Reagent	Volume in milliliters (ml)					
5X TBE	200	210	220	230	240	250
Reagent Grade Water	1800	1890	1980	2070	2160	2250
Total Volume of 0.5X TBE	2000	2100	2200	2300	2400	2500

10X TBE:

Reagent	Volume in milliliters (ml)					
10X TBE	100	105	110	115	120	125
Reagent Grade Water	1900	1995	2090	2185	2280	2375
Total Volume of 0.5X TBE	2000	2100	2200	2300	2400	2500

3. Make 1% SeaKem Gold (SKG) Agarose in 0.5X TBE as follows:
 - a. Weigh appropriate amount of SKG into 500 ml screw-cap flask.
 - b. Add appropriate amount of 0.5X TBE; swirl gently to disperse agarose.
 - c. Remove cap, cover loosely with clear film, and microwave for 60-sec; mix gently and repeat for 15-sec intervals until agarose is completely dissolved.
 - d. Recap flask and place in 55-60°C water bath.

Mix 1.0 g agarose with 100 ml 0.5X TBE for 14-cm-wide gel form (10 wells)

Mix 1.5 g agarose with 150 ml 0.5X TBE for 21-cm-wide gel form (≥15 wells)

SAFETY WARNING: Use heat-resistant gloves when handling hot flasks after microwaving.

4. A small volume (2-5 ml) of melted and cooled (50-60°C) 1% SKG agarose may be wanted to seal wells after plugs are loaded. Prepare 50 ml by melting 0.5 g agarose with 50 ml 0.5X TBE in 250 ml screw-cap flask as described above. Unused SKG agarose can be kept at room temperature, melted, and reused several times. Microwave for 15-20 sec and mix; repeat for 10-sec intervals until agarose is completely melted. Place in 55-60°C water bath until ready to use. Alternatively, save approximately 5 ml of the melted agarose used to cast the gel in a pre-heated (55-60°C) 50 ml flask and place in 55-60°C water bath until used.

Note: Confirm that gel form is level on leveling table, that **front** of comb holder and teeth face the bottom of gel, and that the comb teeth touch the gel platform.

5. Remove restricted plug slices from 37°C water bath. Remove enzyme/buffer mixture and add 200 µl 0.5X TBE. Incubate at room temperature for 5 min.
6. Remove plug slices from tubes; put comb on bench top and load plug slices on the bottom of the comb teeth as follows:
 - a. Load *S. ser.* Braenderup H9812 standards on teeth (lanes) 1, 5, 10 (10-well gel) or on teeth 1, 6, 10, 15 (15-well gel).
 - b. Load samples on remaining teeth.
7. Remove excess buffer with tissue. Allow plug slices to air dry on the comb for ≈5 minutes or seal them to the comb with 1% SKG agarose (55-60°C).
8. Position comb in gel form and confirm that the plugs slices are correctly aligned on the bottom of the comb teeth, that the lower edge of the plug slice is flush against the black platform, and there are no bubbles (if allowed to air dry).
9. Carefully pour the agarose (cooled to 55-60°C) into the gel form.
10. Put black gel frame in electrophoresis chamber. Add 2 -2.2 L freshly prepared 0.5X TBE. Close cover of unit. (The amount of buffer needed depends on whether residual buffer was left in tubing or if unit was flushed with water after the last gel was run.)
11. Turn on power supply to CHEF Mapper, pump (setting of ≈70 for a flow of 1 liter/minute) and cooling module (14°C).
12. Remove comb after gel solidifies for 20 minutes.
13. Fill in wells of gel with melted and cooled (55- 60°C) 1% SKG Agarose (optional). Unscrew and remove end gates from gel form; remove excess agarose from sides and bottom of casting platform with a tissue. Keep gel on casting platform and carefully place gel inside black gel frame in electrophoresis chamber. Close cover of chamber.

B. Loading Restricted Plug Slices into the Wells:

1. Follow steps 1-4 in Option A on pages 7 and 8 (**Loading Restricted Plug Slices on the Comb**).

Note: Confirm that gel form is level on gel-leveling table before pouring gel, that front of comb holder and teeth face bottom of gel, and the bottom of the comb is 2 -mm above the surface of the gel platform.

2. Cool melted SKG agarose in 55-60°C water bath for 15-20 min; carefully pour agarose into gel form (casting stand) fitted with comb. Be sure there are no bubbles.
3. Put black gel frame in electrophoresis chamber. Add 2-2.2 L freshly prepared 0.5X TBE. Close cover of unit. (The amount of buffer depends on whether residual buffer was left in tubing, or if unit was flushed with water after the last gel was run.)

4. Turn on power supply to CHEF Mapper, pump (setting of ≈ 70 for a flow of 1 liter/minute) and cooling module (14°C).
5. Remove restricted plug slices from 37°C water bath. Remove enzyme/buffer mixture and add 200 μ l 0.5X TBE. Incubate at room temperature for 5 minutes.
6. Remove comb after gel solidifies for at least 20 minutes.
7. Remove restricted plug slices from tubes with tapered end of spatula and load into appropriate wells. Gently push plugs to bottom and front of wells with wide end of spatula. Manipulate position with spatula and be sure that are no bubbles.
 - a. Load *S. ser. Braenderup H9812* standards in wells (lanes) 1, 5, 10 (10-well gel) or in wells 1, 6, 10, 15 (15-well gel).
 - b. Load samples in remaining wells.

Note: Loading the plug slices can be tedious; each person has to develop his/her own technique for consistently placing the plug slices in the wells so the lanes will be straight and the bands sharp.

8. Fill in wells of gel with melted 1% SKG Agarose (equilibrated to 55- 60°C). Allow to harden for 3-5 min. Unscrew and remove end gates from gel form; remove excess agarose from sides and bottom of casting platform with a tissue. Keep gel on casting platform and carefully place gel inside black gel frame in electrophoresis chamber. Close cover of chamber.

ELECTROPHORESIS CONDITIONS

- 1a. Select following conditions on Chef Mapper for *Yersinia pestis* restricted with *AscI*
 - Auto Algorithm
 - 25 kb - low MW
 - 215 kb - high MW
 - Select default values except where noted by pressing "enter".
 - Change run time to 17:30 h** (See note below)
 - (Default values: Initial switch time = 1.79 s; Final switch time = 18.66 s)
 - linear ramping factor
- 1b. Select following conditions on CHEF DR II or III.
 - Initial A time: 1.79 s
 - Final A time: 18.66 s
 - Start ratio: 1.0
 - Voltage: 200 V
 - Run time: 20-22 h (DR II); 18-20 h (DR III)

Note: The electrophoresis running times recommended above are based on the equipment and reagents used at the CDC. Run times may be different in your laboratory and will have to be optimized for your gels so that the lowest band in the *S. ser. Braenderup* H9812 standard migrates 1.0 - 1.5 cm from the bottom of the gel.

Day 2

STAINING AND DOCUMENTATION OF PFGE AGAROSE GEL

1. When electrophoresis run is over, turn off equipment (cooling module **FIRST** then pump); remove and stain gel with ethidium bromide. Dilute 40 µl of ethidium bromide stock solution (10 mg/ml) with 400 ml of reagent grade water (this volume is for a staining box that is approximately 14-cm x 24-cm; a larger container may require a larger amount of staining solution). Stain gel for 20 - 30 min in covered container.

Note: Ethidium bromide is toxic and a mutagen; the solution can be kept in dark bottle and reused 4 - 5 times before discarding according to your institution's guidelines for hazardous waste or use the destaining bags recommended for disposal of ethidium bromide (**Section 10**).

2. Destain gel in approximately 500 ml reagent grade water for 60 - 90 min; change water every 20 minutes. Capture image on Gel Doc 1000, Gel Doc 2000, or equivalent documentation system. If background interferes with resolution, destain for an additional 30-60 min.

Note: If both a digital image and conventional photograph are wanted, photograph gel first before capturing digital image.

3. Follow directions given with the imaging equipment to save gel image as an *.img or *.lsc file; convert this file to *.tif file for analysis with the BioNumerics software program (Additional information is in **Section 11** of the PFGE Manual).
4. Drain buffer from electrophoresis chamber and discard. Rinse chamber with 2 L reagent grade water or, if unit is not going to be used for several days, flush lines with water by letting pump run for 5-10 min before draining water from chamber.

Please note the following if PFGE results do not have to be available within 24-28 hours:

1. Plugs can be lysed for longer periods of time (3-16 hours).
2. The washing steps with TE to remove the lysis buffer from the PFGE plugs can be done for longer periods of time (30-45 min) and at lower temperatures (37°C or room temperature). They can be started on Day 1 and finished on Day 2 after overnight refrigeration of the plugs in TE.
3. The restriction digestion can be done for longer periods of time (3-16 hours).
4. If the lowest band in the H9812 standard does not migrate within 1 -1.5 cm of the bottom of the gel, the run time will need to be determined empirically for the conditions in each laboratory.

Use of trade names and commercial sources is for identification purposes only and does not imply endorsement by CDC or the U.S. Department of Health and Human Services.

NOTE: CLIA LABORATORY PROCEDURE MANUAL REQUIREMENTS

Efforts have been made to assure that the procedures described in this protocol have been written in accordance with the 1988 Clinical Laboratory Improvement Amendments (CLIA) requirements for a procedure manual (42 CFR 493.1211). However, due to the format required for training, the procedures will require some modifications and additions to customize them for your particular laboratory operation.

Any questions regarding the CLIA requirements for a procedure manual, quality control, quality assurance, etc., should be directed to the agency or accreditation organization responsible for performing your laboratory's CLIA inspection. In addition, some states and accreditation organizations may have more stringent requirements that will need to be addressed.



Formulas of Selected Reagents used in PulseNet Standardized Laboratory Protocol for PFGE

Tris:EDTA Buffer, pH 8.0 (TE, 10 mM Tris:1 mM EDTA, pH 8.0)⁴

10 ml of 1 M Tris, pH 8.0

2 ml of 0.5 M EDTA, pH 8.0

Dilute to 1000 ml with sterile Ultrapure (Reagent Grade Type 1) Water

Cell Suspension Buffer (100 mM Tris:100 mM EDTA, pH 8.0)

10 ml of 1 M Tris, pH 8.0

20 ml of 0.5 M EDTA, pH 8.0

Dilute to 100 ml with sterile Ultrapure (Reagent Grade Type 1) water

Cell Lysis Buffer (50 mM Tris:50 mM EDTA, pH 8.0 + 1% Sarcosine + 0.1 mg/ml Proteinase K)

25 ml (50 ml) of 1 M Tris, pH 8.0

50 ml (100 ml) of 0.5 M EDTA, pH 8.0

50 ml (100 ml) 10% N-Lauroylsarcosine, Sodium salt (Sarcosyl)

or

5 g (10 g) of N-Lauroylsarcosine, Sodium salt (Sarcosyl)⁵

Dilute to 500 ml (1000 ml) with Sterile Ultrapure (Reagent Grade Type 1) Water

Add 25 µl Proteinase K stock solution (20 mg/ml) per 5 ml of cell lysis buffer just before use for a final concentration in the lysis buffer of 0.1 mg/ml Proteinase K.

Additional enzyme for *Y pestis* PFGE

⁴This formula for TE is from Molecular Cloning - A Laboratory Manual by J. Sambrook and E. Russell, 3rd edition. TE Buffer from Life Technologies (CP0558; 0126A) used at CDC is 0.01M (10 mM) for both ingredients. To duplicate this commercial formula, increase the amount of 0.5 M EDTA to 20 ml per liter.

⁵If Sarcosyl powder is added directly to the other components of this reagent, warm the solution to 50- 60°C for 30-60 minutes, or leave at room temperature for ≈2 hours to completely dissolve the Sarcosyl; adjust to the final volume with sterile Ultrapure Water.

Use the following calculations for *FseI* (40 Units/plug slice):

Reagent	μl/Plug Slice	μl/10 Plug Slices	μl/15 Plug Slices
Sterile Ultrapure Water	163 μl	1630 μl	2445 μl
Buffer 4	20 μl	200 μl	300 μl
BSA	2 μl	20 μl	30 μl
Enzyme <i>FseI</i> (10 U/μl)	15 μl	150 μl	225 μl
Total Volume	200 μl	2000 μl	3000 μl

Note: Keep vial of restriction enzyme on ice or in insulated storage box (-70°C) during storage. Keep *FseI* on ice or in an insulated storage box at all times when in use.

ELECTROPHORESIS CONDITIONS

- 1a. Select following conditions on Chef Mapper for *Yersinia pestis* restricted with *FseI*
 - Auto Algorithm
 - 30 kb - low MW
 - 286 kb - high MW
 - Select default values except where noted by pressing "enter".
 - Change run time to 17:30 h** (See note below)
 - (Default values: Initial switch time = 2.16 s; Final switch time = 25.0 s)
 - linear ramping factor

- 1b. Select following conditions on CHEF DR II or III.
 - Initial A time: 2.16 s
 - Final A time: 25.0 s
 - Start ratio: 1.0
 - Voltage: 200 V
 - Run time: 20-22 h (DR II); 18-20 h (DR III)