



STANFORD LINEAR ACCELERATOR CENTER

Mail Address

Mail Stop 41
 SLAC, P.O. Box 4349
 Stanford, California 94309
 (650) 926-4671

AP-350-990-04**BaBar Detector****Procedure for Opening and Closing the Backward End Doors**

H.J. Krebs,
 February 23, 2000, Revised October 14, 2004

The necessity to open or close the Backward End Doors is normally determined by the BaBar Run Coordinator and all requests to open or close these doors are directed to him. The Run Coordinator also schedules the opening or closing based on discussion with any or all of the following individuals:

BaBar Detector Spokesperson	David MacFarlane, x3406, dbmacf@slac.stanford.edu
BaBar Technical Coordinator	Bill Wisniewski, SLAC x4890, wjw@slac.stanford.edu
BaBar Operations Physicist	Walt Innes, x2653, walt@slac.stanford.edu
BaBar Chief Mech. Engineer	Jim Krebs, x4671, page (650) 849-9425, krebs@slac.stanford.edu
BaBar Safety Officer	Frank O'Neill, x5300, page (650), fgo@slac.stanford.edu
BaBar Safety Physicist	Harvey Lynch, x3691, hll@slac.stanford.edu
IR-2 Hall Manager	Zorb Vassilian, x2464, zxvra@slac.stanford.edu
Accelerator Department Mechanical Group Leader	Scott DeBarger, x4647, page (650) 846-9645, debarger@slac.stanford.edu
PEP-II Interaction Region Mechanical Engineer	Stuart Metcalfe, x8694, page (650) 849 9101, sjm@slac.stanford.edu
PEP-II Project Physicist	John Seeman, x3566, seeman@slac.stanford.edu

CONTENTS	PAGE
1.0 INTRODUCTION	2
2.0 PROCEDURES FOR OPENING THE BACKWARD END DOORS	4
3.0 EARTHQUAKE BRACING THE END DOORS	6
4.0 PROCEDURES FOR CLOSING THE BACKWARD END DOORS	7

1.0 INTRODUCTION

1.1 Reasons for Opening the Backward End Doors.

The Backward End Doors are opened to gain access to each of the following:

- A. DIRC mini-crates around perimeter of SOB.
- B. DIRC photomultiplier tube bases and associated wiring.
- C. DIRC high voltage cables.
- D. DIRC SOB plumbing connections.
- E. DIRC SOB inspection ports.
- F. EMC electronics including ADBs, IOBs, EMBs, TMBs, TRBs, and RMBs.
- G. EMC cabling including CANbus cables, fibers, and power cables.
- H. EMC fluorinert cooling valve manifold.
- I. EMC and Calibration Source miscellaneous plumbing connections.
- J. IFR cooling loop hose connections.
- K. LST cabling and services.

It is also necessary to open the Backward End Doors to perform the following operations:

- A. Open the DIRC SOB doors.
- B. Removal of barrel gap filler plates for access to IFR front end cards in side sextants.
- C. Maintenance and repair of the Backward End Door drive system.
- D. Maintenance and repair of the Backward End Door jack and roller system.
- E. A vertical height adjustment of the detector barrel assembly.
- F. A yaw adjustment of the detector barrel assembly.

1.1 Door Opening Limitations

The nominal travel of the Backward End Doors to the open position is 112.2" (2850 millimeters). This is the location necessary to earthquake brace the end doors. The end doors may be opened several inches beyond this location. The maximum opening distance is limited by the upper portion of the radiation shield wall on the east side and the upper PEP cable trays on the west side.

1.2 Magnetic Field

The magnitudes of the magnetic fields in the superconducting solenoid coil and the bucking solenoid coil must be zero with their corresponding power supply breakers turned off and lock-and-tag padlocks installed prior to commencing the opening procedures. The authorization to begin the end door opening sequence is provided by the BaBar shift leader.

1.3 Curtain Wall and Overhead Crane

The overhead crane is not needed to open the Backward End Doors. Therefore, it is not necessary to open the curtain wall prior to opening the doors. However, the overhead crane is needed to install the earthquake braces that mechanically connect the end doors to the detector barrel assembly (see Section 3.0).

1.4 Hall Crew

The opening procedures require a four man crew consisting of:

CREW LEAD (1 Required)

Zorb Vassilian, x2464

Jim Krebs, x4671, page (650) 849-9425

MECHANICAL TECHNICIANS (3 Required)

Scot Johnson, x5181, page (650) 846-0909

Jason Krebs, x8784, page (650) 991-8430

Andrew Hau, x8789, page (650) 404-9519

1.5 Crew Responsibilities

CREW LEAD: The Crew Lead supervises the Mechanical Technicians and is responsible for safety in the immediate and surrounding area during the opening/closing sequence.

MECHANICAL TECHNICIANS: One individual controls the pendant and drives the end door. The second individual is placed on the upper door platform and removes/install the upper tie rods. He also watches for interferences between the end door and other objects during door motion. Any individual on top of the end door must be wearing fall protection. The third individual is placed at the floor level and removes/install the lower tie rods. He also watches for interferences during door motion and continuously monitors the alignment of the Hilman rollers relative to the tracks.

2.0 PROCEDURES FOR OPENING THE BACKWARD END DOORS (45 minutes per end door)

There is no preference between opening the east end door or the west end door first.

- 2.1 Receive notification from the BaBar Shift Leader (usually Run Coordinator) that the superconducting solenoid and the bucking coil are de-energized with the power supply breakers (located in Building 625) turned off and the lock-and-tag padlocks installed.
- 2.2 Turn the key switch on the administrative interlock (located on the southeast wall in the collision area) counter-clockwise to the "DISABLED" position and remove the key.
- 2.3 Store the key to the administrative interlock in the key bank located in room 203 (second floor) of Building 621 (IR-2 Hall Manager's office).
- 2.4 Remove the key for the end door drive circuit breaker lock-and-tag padlock from the key bank located in room 203 (second floor) of Building 621 (Ir-2 Hall Manager's office).
- 2.5 Remove the lock-and-tag padlock from the Backward End Door drive circuit breaker (located on the southeast wall in the collision area) and turn the circuit breaker lever upward to the "ON" position.
- 2.6 Retrieve the drive control pendant from the gray storage cabinet located at the northeast corner of the interaction region.
- 2.7 Clean the door tracks and the cam follower slot of any debris that may hinder the end door jack and roller system.
- 2.8 Push down the "EMERGENCY STOP" mushroom button on the top of the drive control box. A red LED on top of the box will flash when the button is pushed down.
- 2.9 Set the direction toggle switch on the pendant to its center position (neutral).
- 2.10 Turn the pendant's speed control potentiometer all the way counter-clockwise to the "SLOW/STOP" position.
- 2.11 Flip the Guides switch to the "UP" position.
- 2.12 Connect the pendant to the control box side connector (located on the white end door DIRC magnetic shield door).
- 2.13 The "EMERGENCY STOP" mushroom button should be pulled to the out position on the bypass control box (mounted to the walkway handrail).
- 2.14 The "EMERGENCY STOP" mushroom button should be pulled to the out position on the drive control box (located on the white end door DIRC magnetic shield door).
- 2.15 On the end door drive pendant, set the direction toggle switch to the "IN" position. This is the closing position.
- 2.16 With the "BYPASS" button held in (on bypass control box), turn the speed control potentiometer (on drive pendant) clockwise and drive the drive screw nut plate toward the end door skid plate. Turn the speed control potentiometer counter-clockwise to the "SLOW/STOP" position when the nut plate is in contact with the skid plate.
- 2.17 Release the "BYPASS" button.
- 2.18 On the end door drive pendant, set the selector toggle switch to its center position (neutral).
- 2.19 Connect the drive screw nut plate to the end door skid plate by turning the clamp brackets and tightening the 1-8UNC hex bolts (1.5" hex head). [4]
- 2.20 Break the mechanical connection between the lower cover plate and the fixed inner cylinder by removing the 3/4-10UNC hex bolts (1.125" hex head) with standard washers and large washers from the inner bolt pattern. [5]
- 2.21 If the movable inner cylinder has been removed proceed to step 2.23.
- 2.22 Break the mechanical connection between the upper cover plate and the white movable inner cylinder by removing the 3/4-10UNC hex bolts with standard washers and large washers from the inner bolt pattern. See procedure AP-350-990-05.[8]

(Open Backward End Doors Continued)

- 2.23 Loosen the 1½-6UNC tie rods from the top of the Backward End Door. Pull the tie rods out. The tie rods are spring loaded to aid extraction but care should be taken to assure that the extraction is far enough to allow movement of the end door without interference with the detector barrel assembly. The “TOP RODS” LED will change from red to green. [6]
- 2.24 Loosen the 1½-6UNC tie rods from the bottom of the Backward End Door. Pull the tie rods out. The tie rods are spring loaded to aid extraction but care should be taken to assure that the extraction is far enough to allow movement of the end door without interference with the detector barrel assembly. [6].
- 2.25 Install the aluminum plate that prevents the tie rods from being accidentally extended into the motion of the end door. The aluminum plate will close the interlock switch to allow the drive system to function. The “SKID RODS” LED will change from red to green.
- 2.26 Connect the air pressure hose to the air cylinder system’s quick-disconnect coupling.
- 2.27 Turn on the house air supply valve. The “AIR” LED will change from red to green. The “GUIDES DOWN” LED comes on red.
- 2.28 Connect the hydraulic pump to the jack hydraulic system’s four-way valve manifold.
- 2.29 Plug the hydraulic pump electrical cord into a 110VAC electrical outlet.
- 2.30 Adjust the alignment of the southern most Hilman rollers relative to the track. These rollers are suspended from the end door skid and may be adjusted by hand prior to pressurizing the hydraulic jacks.
- 2.31 Turn on the hydraulic pump and pressurize the end door jacks to 10,000 psi. When the skid is up the “SKID UP” LED will change from red to green.
- 2.32 Check to make sure the end door is raised by sliding a piece of paper under the skid feet. If the door is not raised check the hydraulic circuit. [5]
- 2.33 Close the valve on the pump to lock the jacks in the raised position.
- 2.34 Turn off the hydraulic pump.
- 2.35 Extend the air cylinder rams by setting the switch to the “DOWN” position on the drive control box. The “GUIDES DOWN” LED will change from red to green.
- 2.36 Visually check to assure that the air cylinder cam followers are now engaged in the cam follower slot of the end door track. [2]
- 2.37 On the pendant, set the direction toggle switch to the “OUT” position. This is the opening position.

Warning: Do NOT attempt to move the end door unless ALL LEDs are green.

- 2.38 Adjust the speed control potentiometer clockwise to drive the end door out of its normally closed position. Adjust the door movement speed by turning the pendant’s speed control potentiometer clockwise for faster and counter-clockwise for slower.
- 2.39 Stop the end door and check the alignment of the Hilman rollers every three feet of travel. A maximum roller misalignment of ½” from end to end is tolerable. If the roller alignment is satisfactory, go to step 2.43. [2]
- 2.40 On the end door drive pendant, set the direction toggle switch to the center position (neutral).
- 2.41 On the pendant, flip the “GUIDES” switch to the “UP” position. The air cylinder rams will extract the cam followers from the track slot and the “GUIDES DOWN” LED will change from green to red on the drive control box.
- 2.42 Open the locking valve on the hydraulic pump and bleed the pressure off of the end door jacks. When the skid is down the “SKID UP” LED will change from green to red.
- 2.43 Go to step 2.29.

(Open Backward End Doors Continued)

- 2.44 Extract the end door approximately 112.2" (2850 millimeters). This is the location necessary to properly install the end door earthquake braces (see Section 3.0). When the end door has reached the desired location, turn the speed control potentiometer all the way counter-clockwise to the "SLOW/STOP" position.
- 2.45 On the end door drive pendant, set the direction toggle switch to the center position (neutral).
- 2.46 On the pendant, flip the "GUIDES" switch to the "UP" position. The air cylinder rams will extract the cam followers from the track slot and the "GUIDES DOWN" LED will change from green to red on the drive control box.
- 2.47 Open the locking valve on the hydraulic pump and bleed the pressure off of the end door jacks. When the skid is down the "SKID UP" LED will change from green to red.
- 2.48 Push down the "EMERGENCY STOP" mushroom button on the top of the drive control box. A red LED on top of the box will flash when the button is pushed down.
- 2.49 Disconnect the pendant from the control box side connector.
- 2.50 Turn off the house air supply at the source. The "AIR" LED will change from green to red.
- 2.51 Disconnect the air pressure hose from the air cylinder system's quick-disconnect coupling, coil it up and store it on the west wall.
- 2.52 Disconnect the hydraulic pump from the jack hydraulic system's four-way valve manifold, coil up the hose and store it with the hydraulic pump (near north wall).
- 2.53 Repeat steps 2.7 through 2.51 if opening the other backward end door.
- 2.54 Store the drive control pendant in the gray storage cabinet located at the northeast corner of the interaction region.
- 2.55 Unplug the hydraulic pump electrical cord from the 110VAC electrical outlet.
- 2.56 Flip the lever of the Backward End Door drive circuit breaker down to the "OFF" position.
- 2.57 Insert and lock the lock-and-tag padlock on the circuit breaker to avoid the possibility of accidentally powering the drive system during the access period.
- 2.58 Return the key for the end door drive circuit breaker lock-and-tag padlock to the key bank located in room 203 (second floor) of Building 621.

3.0 EARTHQUAKE BRACING THE END DOORS (90 minutes for installation or removal per end door)

It is the policy of the BaBar Detector Collaboration to earthquake brace the end doors to the detector barrel assembly if the access period extends longer than seven calendar days. The installation and removal of the earthquake braces requires the use of the overhead crane. Therefore, the curtain wall must be open and the IR-2 Hall in "PERMITTED ACCESS" for these operations. There is an upper brace and a lower brace for each door. The braces are painted red with a unique identifier on each. They are stored in the assembly area of IR-2 when not in use.

It may be necessary to adjust the position of the end door slightly for the earthquake braces to fit properly (see Sections 2.0 and 4.0). The lower braces are installed first with ten 1½-6UNC hex bolts between the brace and the barrel and also ten 1½-6UNC hex bolts between the brace and the end door. The upper braces are installed with four 1½-6UNC hex bolts between the brace and the barrel and also four 1½-6UNC hex bolts between the brace and the end door. It may be necessary to shim between the braces and the end door to provide the proper mechanical

(Earthquake Bracing the End Doors Continued)

connection. All bolts should have flat washers and torqued to approximately 2000 ft-lb. It may be necessary to set the lower northwest earthquake brace on the floor and re-sling for installation.

Removal of the earthquake braces is performed opposite of the installation with the upper braces removed first and the lower braces removed after. Again, it may be necessary to set the lower northwest earthquake brace on the floor and re-sling for removal.

4.0 PROCEDURES FOR CLOSING THE BACKWARD END DOORS (45 minutes per end door)

There is no preference between closing the east end door or the west end door first. Both the top and lower earthquake braces must be removed before commencement of the door closing procedures (see Section 3.0). Closing tolerances are very tight and cabling and piping have been damaged during previous closing procedures. Therefore as a courtesy, the following individuals should be notified of the intent to close the backward doors:

Robert Reif, x2386, page (650) 849-9499

- 4.1 Receive notification from the BaBar Shift Leader (usually Run Coordinator) that the Backward End Doors should be closed.
- 4.2 Remove the key for the end door drive circuit breaker lock-and-tag padlock from the key bank located in room 203 (second floor) of Building 621 (Ir-2 Hall Manager's office).
- 4.3 Remove the lock-and-tag padlock from the Backward End Door drive circuit breaker (located on the southeast wall in the collision area) and turn the circuit breaker lever up to the "ON" position.
- 4.4 Plug the hydraulic pump electrical cord into a 110VAC electrical outlet.
- 4.5 Search the detector barrel face, floor and end door for tools, fasteners or other potentially magnetic materials. This search should be performed by the IR-2 Hall Manager or the BaBar Chief Mechanical Engineer as a part of the check list for "Preparing for BaBar Magnet Ramp Up" (provided by the Cryo Operations Group).
- 4.6 Perform visual inspection of Bucking Coil power leads and connections to assure that insulating materials have not been damaged or removed (east end door only). This inspection should be performed by the IR-2 Hall Manager or the BaBar Chief Mechanical Engineer as a part of the check list for "Preparing for BaBar Magnet Ramp Up" (provided by the Cryo Operations Group).
- 4.7 Retrieve the drive control pendant from the gray storage cabinet located at the northeast corner of the interaction region.
- 4.8 Remove scissors lift and ladders, if applicable.
- 4.9 Clean the door tracks and the cam follower slot of any debris that may hinder the end door jack and roller system.
- 4.10 Connect the DIRC touch sensor display.
- 4.11 Push down the "EMERGENCY STOP" mushroom button on the top of the drive control box. A red LED on top of the box will flash when the button is pushed down.
- 4.12 Set the direction toggle switch on the pendant to its center position (neutral).

(Close Backward End Doors Continued)

- 4.13 Turn the pendants speed control potentiometer all the way counter-clockwise to the "SLOW/STOP" position.
- 4.14 Flip the Guides switch to the "UP" position.
- 4.15 Connect the pendant to the control box side connector.
- 4.16 The "EMERGENCY STOP" mushroom button should be pulled to the out position on the bypass control box (mounted to the walkway handrail).
- 4.17 The "EMERGENCY STOP" mushroom button should be pulled to the out position on the drive control box (located on the white end door DIRC magnetic shield door).
- 4.18 On the end door drive pendant, set the direction toggle switch to the "IN" position. This is the closing position.
- 4.19 The aluminum plate that closes the drive system interlock switch for the lower tie rods must be in place.
- 4.20 Connect the air pressure hose to the air cylinder system's quick-disconnect coupling.
- 4.21 Turn on the house air supply valve. The "AIR" LED will change from red to green. The "GUIDES DOWN" LED comes on red.
- 4.22 Connect the hydraulic pump to the jack hydraulic system's four-way valve manifold.
- 4.23 Adjust the alignment of the southern most Hilman rollers relative to the track. These rollers are suspended from the end door skid and may be adjusted by hand prior to pressurizing the hydraulic jacks.
- 4.24 Turn on the hydraulic pump and pressurize the end door jacks to 10,000 psi. When the skid is up the "SKID UP" LED will change from red to green.
- 4.25 Check to make sure the end door is raised by sliding a piece of paper under the skid feet. If the door is not raised check the hydraulic circuit. [5]
- 4.26 Close the valve on the pump to lock the jacks in the raised position.
- 4.27 Turn off the hydraulic pump.
- 4.28 Extend the air cylinder rams by setting the switch to the "DOWN" position on the drive control box. The "GUIDES DOWN" LED will change from red to green.
- 4.29 Visually check to assure that the air cylinder cam followers are now engaged in the cam follower slot of the end door track. [2]
- 4.30 On the pendant, set the direction toggle switch to the "IN" position. This is the closing position.

Warning: Do NOT attempt to move the end door unless ALL LEDs are green.

- 4.31 Adjust the speed control potentiometer clockwise to drive the end door toward its normally closed position. Adjust the door movement speed by turning the pendant's speed control potentiometer clockwise for faster and counter-clockwise for slower.
- 4.32 Stop the end door and check the alignment of the Hilman rollers every three feet of travel. A maximum roller misalignment of 1/2" from end to end is tolerable. If the roller alignment is satisfactory, go to step 4.36. [2]
- 4.33 On the end door drive pendant, set the direction toggle switch to the center position (neutral).
- 4.34 On the pendant, flip the "GUIDES" switch to the "UP" position. The air cylinder rams will extract the cam followers from the track slot and the "GUIDES DOWN" LED will change from green to red on the drive control box.
- 4.35 Open the locking valve on the hydraulic pump and bleed the pressure off of the end door jacks. When the skid is down the "SKID UP" LED will change from green to red.
- 4.36 Go to step 4.22.

(Close Backward End Doors Continued)

- 4.37 Close the end door. Monitor the DIRC touch sensor display to avoid closing the end door too far. When the end door has reached the desired location, turn the speed control potentiometer all the way counter-clockwise to the "SLOW/STOP" position.
- 4.38 On the end door drive pendant, set the direction toggle switch to the center position (neutral).
- 4.39 On the pendant, flip the "GUIDES" switch to the "UP" position. The air cylinder rams will extract the cam followers from the track slot and the "GUIDES DOWN" LED will change from green to red on the drive control box.
- 4.40 Open the locking valve on the hydraulic pump and bleed the pressure off of the end door jacks. When the skid is down the "SKID UP" LED will change from green to red.
- 4.41 Remove the aluminum plate that prevents the lower tie rods to be installed.
- 4.42 Insert the upper tie rods. Begin threading the rods with hand tools such as a ratchet and socket. A minimum of five of the six tie rods must engage including the rod with the magnet power supply interlock switch. This is the inner most tie rod. Do not torque the tie rods at this point.
- 4.43 Insert the lower tie rods. Begin threading the rods with hand tools such as a ratchet and socket. A minimum of five of the six tie rods must engage. Do not torque the tie rods at this point.
- 4.44 Determine that the proper tie rod engagement exists on both upper and lower rods. This is the main test to conclude that the end door is in the closed position. It may be necessary to extract the rods, raise and move the door, and lower the door again to adjust the position. This sequence must be repeated until the proper tie rod engagement exists.
- 4.45 Torque the upper tie rods to approximately 1650 foot pounds (4300 psi with Hytorq hex link, 5100 psi with Hytorq square drive).
- 4.46 Torque the lower tie rods to approximately 1650 foot pounds.
- 4.47 Disconnect the drive screw nut plate from the end door skid plate by loosening the 1-8UNC hex bolts (1.5" hex head) and turning the clamp brackets. [4]
- 4.48 On the end door drive pendant, set the direction toggle switch to the "OUT" position. This is the opening position.
- 4.49 With the "BYPASS" button held in (on bypass control box), turn the speed control potentiometer (on drive pendant) clockwise and drive the drive screw nut plate away from the end door skid plate. Turn the speed control potentiometer counter-clockwise to the "SLOW/STOP" position when the nut plate is 8.5" minimum from the clamp bracket bolt heads.
- 4.50 Release the "BYPASS" button.
- 4.51 On the end door drive pendant, set the selector toggle switch to its center position (neutral).
- 4.52 Push down the "EMERGENCY STOP" mushroom button on the top of the drive control box. A red LED on top of the box will flash when the button is pushed down.
- 4.53 Disconnect the pendant from the control box side connector.
- 4.54 Turn off the house air supply at the source. The "AIR" LED will change from green to red.
- 4.55 Disconnect the air pressure hose from the air cylinder system's quick-disconnect coupling, coil it up and store it on the west wall.
- 4.56 Disconnect the hydraulic pump from the jack hydraulic system's four-way valve manifold, coil up the hose and store it with the hydraulic pump (near north wall).
- 4.57 Repeat steps 4.5 through 4.54 if closing the other backward end door.
- 4.58 Store the drive control pendant in the gray storage cabinet located at the northeast corner of the interaction region.

(Close Backward End Doors Continued)

- 4.59 Unplug the hydraulic pump electrical cord from the 110VAC electrical outlet.
- 4.60 Flip the lever of the Backward End Door drive circuit breaker down to the "OFF" position.
- 4.61 Insert and lock the lock-and-tag padlock on the circuit breaker to avoid the possibility of accidentally powering the drive system.
- 4.62 Return the key for the end door drive circuit breaker lock-and-tag padlock to the key bank located in room 203 (second floor) of Building 621.