Quality Assurance Plan

The ISU Quality Assurance plan is based in part on information contained in the RFP Statement of Work, the MOU between Jefferson Lab and ISU regarding the Region 1 Drift Chamber construction, and the Jefferson Lab *Wire Stringers Manual*. Note that the *Wire Stringers Manual* is subject to modification by mutual consent.

This QA plan contains information about the performance and documentation of the cleaning protocol, set-up and assembly procedures, stringing team work, the status of the cleanroom, particle counts, cleaning schedule, personnel involved, equipment and supplies used, equipment testing and materials certifications, testing procedures, and documentation.

We plan to record testing information such as wire tensions in a database that will be available to both ISU and Jefferson Lab project personnel for periodic review. The stringing teams will be specially trained for precision wire installation and will be responsible, as will the ISU key personnel, for the continuous adherence to the procedures in this Quality Assurance Plan.

i. **Acquisition of the approved Assembly Drawings plan sets to**
   a. use for the parts inventory and as a reference checklist (as required by the S.O.W., Part 1.5,h)
   b. use as a reference for all part measurements and for the calibrations of tools.
   c. have drawings available to review and discuss assembly procedures as needed.

ii. b. Maintain a Cleanroom at ISU
   a. Use a calibrated particle counting device to monitor and maintain air quality in the cleanroom, with positive laminar airflow.
   b. Establish a schedule to clean the cleanroom as needed to maintain low particle counts and to monitor the HEPA pre-filters for replacement.
   c. Maintain a temperature of 70 degrees F in the clean room within plus or minus 2 degrees F.

iii. Parts cleaning
   a. Cleaning of all parts as required, prior to assembly, using the recommended cleaners and methods as prescribed by Jefferson Lab to be free of any machining oil, etc., to a minimum vacuum standard.
   b. Store and inspect all cleaned parts before use in a controlled environment.

iv. **Inspection and documentation**
   a. Obtain and document the relevant material certifications and analyses as necessary.
   b. Identification of standards for inspection of materials and parts to be used.

c. Calibration of instrumentation used in the inspection and testing of parts and materials.
d. Define intervals of calibrations for test equipment.
e. Determine an inspection and survey schedule to measure critical parameters.
f. Record all inspection and calibration information gathered into the Chamber Assembly Database.

v. Chamber Assembly in the Clean Room

a. Inspect the chamber boxes shipped to ISU that were assembled by JLab
b. Document findings in the database.
c. Do a final cleaning.
d. Install the finished chamber onto its strongback fixture.

vi. Wire Stringing the Chambers

Using techniques and procedures included in the *Wire Stringers Manual*, proceed with the installation of the guard, field and sense wires in each of six Region 1 chambers, testing each wire for continuity and for the specific tension(s) required, while documenting the test readings in the Chamber Testing Database.

a. Align and secure the fixtures in preparation for stringing.
b. Lift and install the assembly cart fixture onto the stringing fixture with the gantry crane.
c. Install all stringing equipment, wire machines, tension roller bars, etc.
d. Install the clear protective stringing cover over the open ends of the chamber.
e. Install the pre-tensioning devices and check for accuracy and correct tension.
f. The stringing team begins wire stringing operations, including tension and continuity tests on each wire.
g. Document all test results in the Chamber Stringing Database.
h. Perform a final inspection and correct any defects found.
i. Seal all crimp pins with potting glue in the feed-through end cups as a gas seal.

vii. Install and Test the Chamber Gas Envelope

a. Install gas envelope and sealing hardware.
b. Fill the chamber with a non-explosive mixture of Argon and Methane in a 90/10 mixture by volume.
c. Use the 90/10 Argon/Methane gas blend and a flammable gas detector to find and correct any leaks.

d. Purge the chamber with dry air or with the operating mixture of 90/10 Argon CO2.

viii. Wire Wrap

a. Wrap all field wires daisy chained in groups.
b. Wrap all guard wires daisy-chained in groups.
c. Perform continuity check and final inspection, document results.

ix. Installing the PC Boards

a. Install the mounting hardware.
b. Mount the printed circuit boards to the chamber.
c. Install the conductive tubing connecting the crimp pins to the PC boards, install the plastic securing caps.
d. Test continuity between wire crimp pin and circuit board.
e. Install the PC board gas covers.
f. Clean, inspect and document the work.

x. Performance Testing the Chambers

a. Flow Ar/CO_2 gas mixture (90/10) to the chamber prior to HV testing.
b. Flow nitrogen across the electronics boards prior to HV testing.
c. Measure the current drawn by each group of sense wires.
d. "Backfire" individual sense wires, if necessary, to reduce current drawn.
e. Run performance tests on all chambers through the voltage ranges to observe the expected counting rate plateau.
f. Document all test results in the Chamber Testing Data Base during procedures.
g. Provide all test data to the P.I. and Jefferson Lab Project Managers for review to ensure the chambers meet performance specifications.

xi. **Prep for shipping to Jefferson Lab**

a. Cover the chamber and PC boards with protective material.
b. Install the shipping bumper to the fixture.
c. Place chamber in shipping crate.
d. Install the crate shock absorber system and shock detecting labels for shipping.
e. Ship the crate to Jefferson Lab.