RONDOUT TUNNEL PROJECT

TUNNEL CONSTRUCTION PROJECT

Project Name	Rondout Tunnel Project
Client	New York City Environmental Protection (NYC DEP)
Main Subcontractor	Kiewit/Shea JV
Location	New York, USA
Product	Access Chambers
Total Tonnage	335 MT
Delivery Date	2018

INTRODUCTION

Originally placed into service in 1944, the Rondout-West-Branch Tunnel (RWB) is a section of the Delaware Aqueduct, which supplies nearly 60% of the water for New York City. The aqueduct also is the primary source of water for several upstate communities. The 13.5-foot-diameter (4.1 m) rock RWB Tunnel is approximately 45 miles (72 km) long, ranges in depth from 300 to 2,300 feet (91–701 m), and operates with an internal head of up to 1,200 feet (366 m). It was constructed during the late 1930s and 1940s using drill-and-blast methods. Most of the tunnel has an un-reinforced concrete liner. In areas of poor ground conditions and significant groundwater inflow during construction, steel "interliners" were incorporated in the lining system.

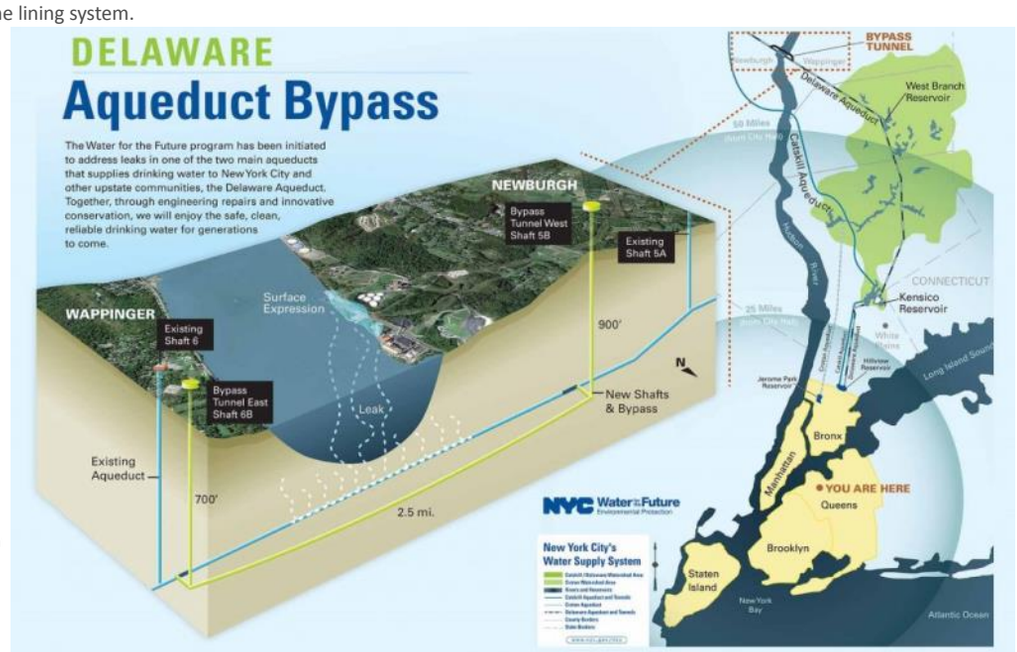
Since about 1970, leakage has been observed at the ground surface, especially in an area immediately west of the Hudson River near Roseton, New York. The geology in this area of the alignment is complex. The depth, from ground surface to the existing tunnel at the Hudson River, ranges from 600 to 900 feet (183–274 m).

Rondout-West Branch Tunnel (RWBT) is currently leaking between 15 and 35 million gallons per day. DEP plans to address the leaks in RWBT by undertaking the RWBT repair program, which consists of:

Constructing a bypass tunnel around the leaking areas in Roseton.

Repair of Aqueduct in Wawarsing.

Developing water supply augmentation projects.



ESC SCOPE OF SUPPLY

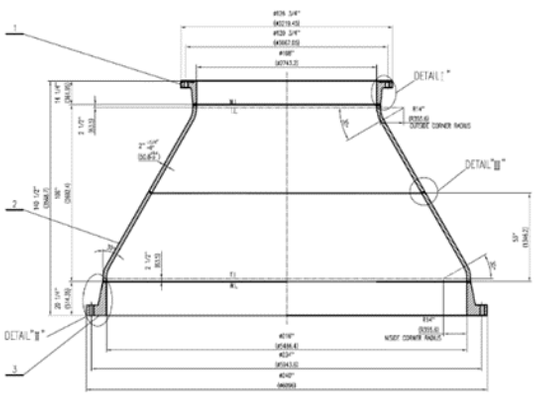
STEEL STRUCTURES

ESC was awarded the supply 2 sets of access chambers for the construction of Rondout west branch bypass tunnel in USA.

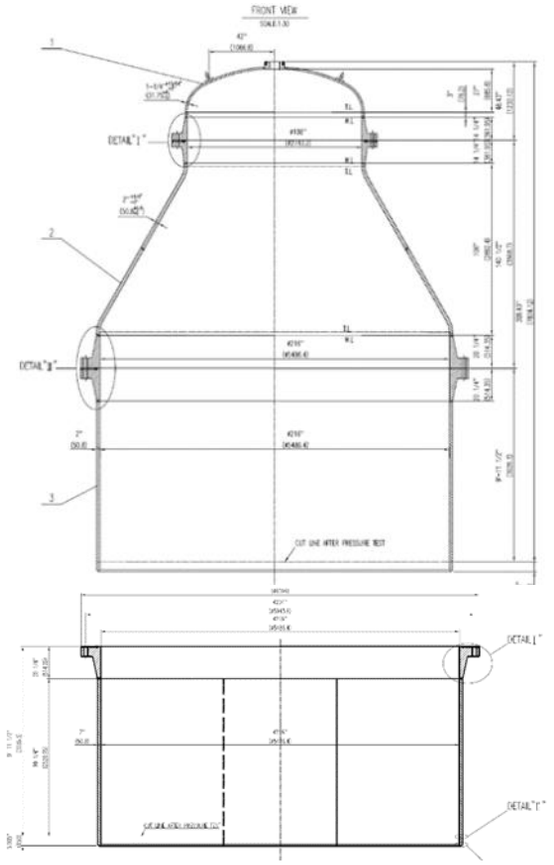
The access chambers are manufactured in accordance with ASME Section VIII – Rules for Construction of Pressure Vessel.

Each set of access chambers consist of the following components:

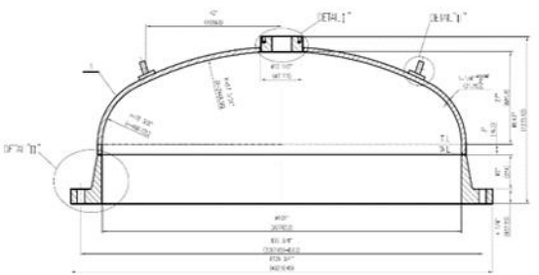
- Shaft cap with flange
- Transition fitting with flange
- Access pipe with flange
- Other accessories (stud & nut, O-ring, and plug for telltale hole)



Transition Fitting: ASTM A537 Class 1
ID216” & ID108” Flange: ASTM A105(N)

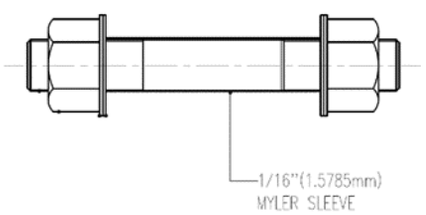


Access Pipe: ASTM A572 Gr.50
ID216” Flange: ASTM A105(N)



Shaft Cap: ASTM A516 Gr.70
ID108” Flange: ASTM A105(N)

STUD, NUT AND WASHER



Size 1 (296 sets, each set with 2 phenolic washers & 2 plain washers): Stud 2 ¼”-4.5UNC-2A, L20”, ASTM A564/A564M Gr.630 H1150; Heavy Hex Nut 2 ¼”-4.5UNC-2B, ASTM A564/A564M Gr.630 H1150

Size 2: (144 sets, each set with 2 phenolic washers & 2 plain washers): Stud 2”-4.5UNC-2A, L=14 ½”, ASTM A564/A564M Gr.630 H1150; Heavy Hex Nut 2”-4.5UNC-2B, ASTM A564/A564M Gr.630 H1150

Size 3: (24 sets, without washer): Stud ¾”-10UNC-2A, L4.5”, ASTM A193/A193M Class 2:B8M, Nut ¾”-10UNC-2B, ASTM A194/A194M 8M

All studs are required to be tested via a tensile test, impact test, and hardness test.

All nuts are required to be tested via a hardness test and a proof load test.

¾” nut proof load shall be at least 133.5kN

2” nut proof load shall be at least 701kN

2 ¼” nut proof load shall be at least 911kN

There are very limited stud & nut manufacturer or testing lab in China that possess the capability to test the proof load for nut of 2” (701kN) and 2 ¼” (911kN). ESC sent these nuts to a government CNAS test lab in order to perform the proof load test for the 2” and 2 ¼” nut.

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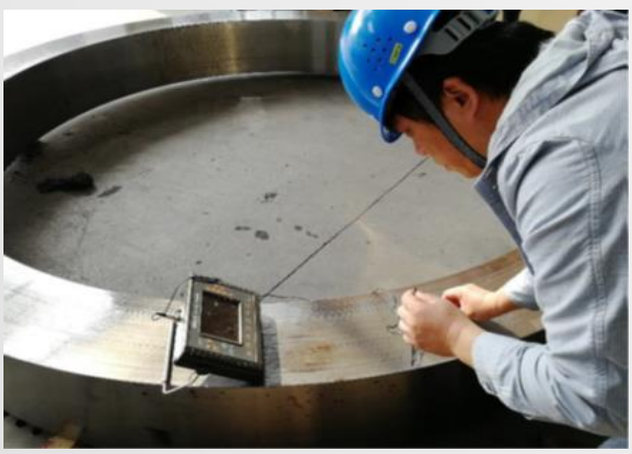
CLIENT AUDIT

Client representatives from NYC DEP and Kiewit performed supplier audit prior to the commencement of the project. The scope of this audit included the main fabricator's facility and other components supplier's facilities (shaft cap, flange, transition fitting, access pipe, stud and nut, and O-ring).

INCOMING MATERIAL INSPECTION



An inspector from NYC DEP and ESC own QA/QC staff were based in the workshop to witness the entire fabrication process from incoming raw material inspection to the painting process.

Samples are cut from each material to perform in-house mechanical properties and chemical composition retest for each heat number.

Another set of samples from each heat number is couriered to the USA for client retest in their lab.

A 100% lamination ultrasonic test is performed on each material (flanges and steel plates).

FABRICATION OF FLANGES & OTHER ACCESSORIES

FABRICATION OF SHAFT CAPS

Picture 1 – Forming of Shaft Cap

Picture 2 – Shaft cap welded with accessories (lifting lug & shaft cap insert) and tack welded with flange.

Picture 3 – Welding of shaft cap with flange

Picture 4 – Shaft cap welded with flange

FABRICATION OF TRANSITION FITTINGS

FABRICATION OF ACCESS PIPES

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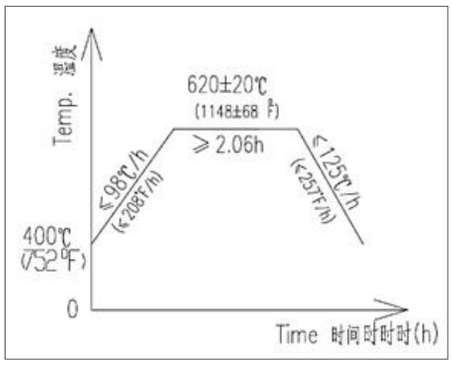
POST WELD HEAT TREATMENT

Each part of the access chamber (shaft cap, transition fitting, and access pipe) are heat treated separately after the welding process.

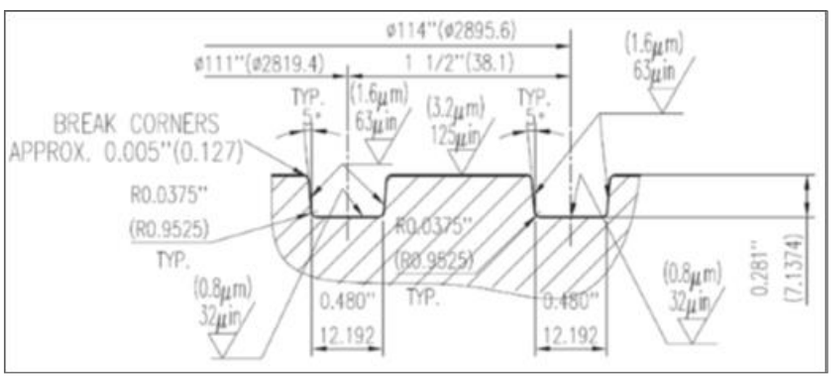
Each part is braced before the heat treatment process to prevent deformation.



FINAL MACHINING

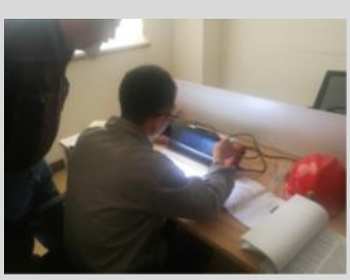
Surface roughness requirements:

The flange face is machined to achieve the surface roughness requirements of Ra = 0.8μm (for O-ring groove seating surface), 1.6μm (for O-ring groove wall), and 3.2μm (flange sealing face) in accordance with ASME B46.1.



INSPECTION

1. 100% RT performed on all full penetration welds.
2. 100% PT performed on root pass after back gouging for butt welding.
3. Perform PT and thickness inspection on surface where temporary attachment are cut removed.
4. Perform mechanical test using the welding test plate prepared during actual production.



HYDROSTATIC TEST (BOLT TORQUEING)

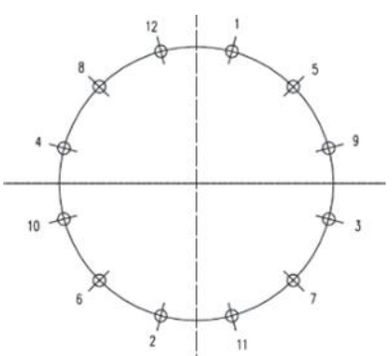
All nut with “P” and “T” marking. Only nut with “T” marking are used during hydrostatic test, and will be discarded after hydrostatic test.

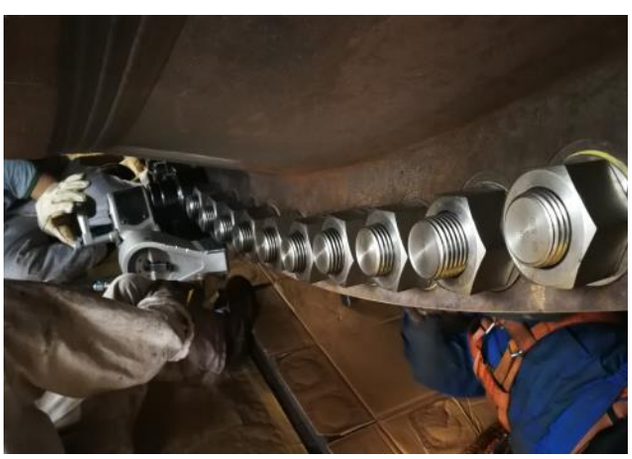
All studs & nuts are tightened using a hydraulic torque wrench.

The required stud & nut tension force for ID108” flange is 72,000lbf and for ID216” flange is 110,000lbf.

The required torque in order to achieve the tension force is calibrated using a Skidmore Wilhelm Model K-100 before the stud and nut are assembled.

All studs and nuts are tightened using multi-pass tightening torque at 50%, 80%, and 100% final target torque. The studs and nuts are tightened according to the star pattern. Thread of the studs are lubricated with molybdenum disulphide grease prior to tightening process.





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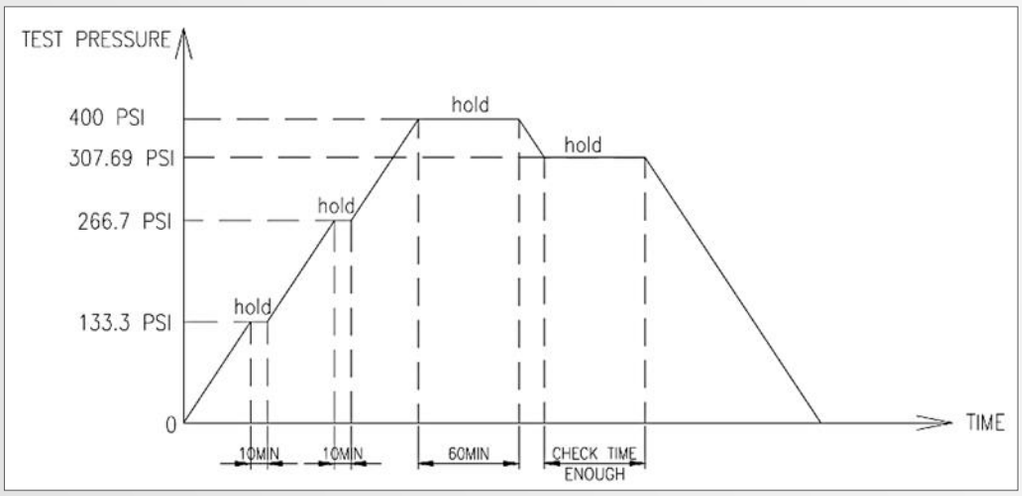
HYDROSTATIC TEST

Hydrostatic test pressure equal to 400psi applied gradually for a period not less than 10 minutes at stage 1/3 (133.3psi), 2/3 (266.7psi), and full max pressure (400psi) not less than 60 minutes. The water temperature for the hydrostatic test is controlled to ensure that it is more than 4.5°c. Overall inspection on all welds and sealed surface is carried out at the pressure of 307.69psi to ensure no leakage (check the pressure gage, no pressure drop is allowed).



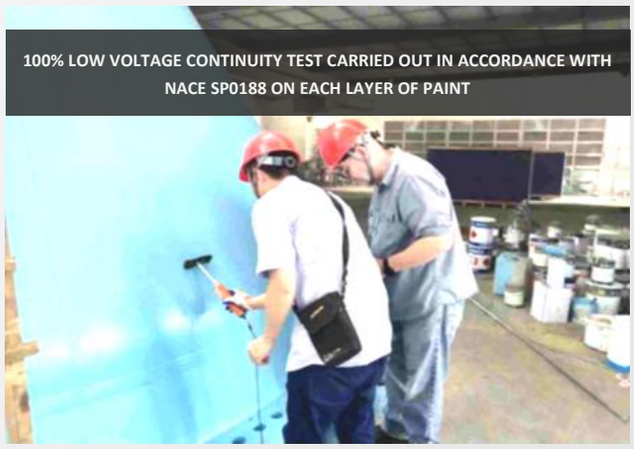
BLASTING & PAINTING

Surface preparation: blasting to Sa2.5, surface roughness inspection, ambient condition inspection, and dust test.

Surface cleanliness: Sa2.5

Paint: PPG Amerlock 400 epoxy

Total DFT: 229 ~ 381μ



100% LOW VOLTAGE CONTINUITY TEST CARRIED OUT IN ACCORDANCE WITH NACE SP0188 ON EACH LAYER OF PAINT

MASKING

PAINTED TRANSITION FITTING

DFT INSPECTION CARRIED OUT IN ACCORDANCE WITH SSPC PA2 STANDARD

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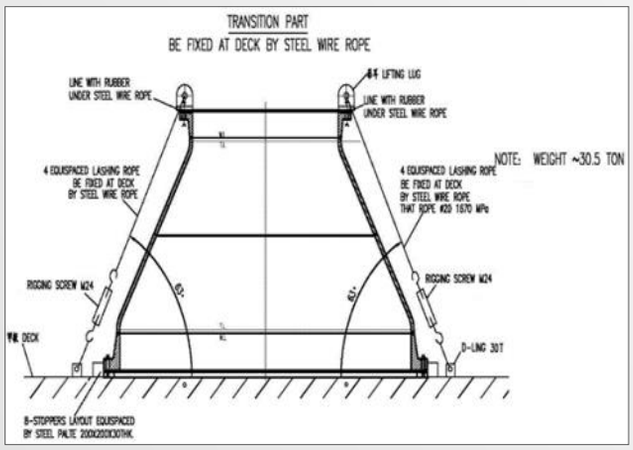
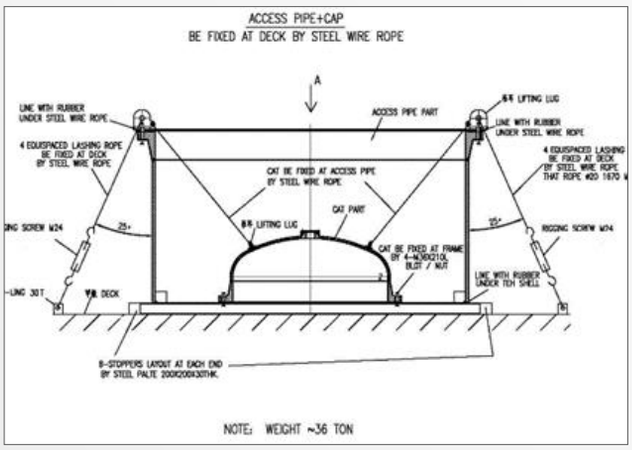
PACKING

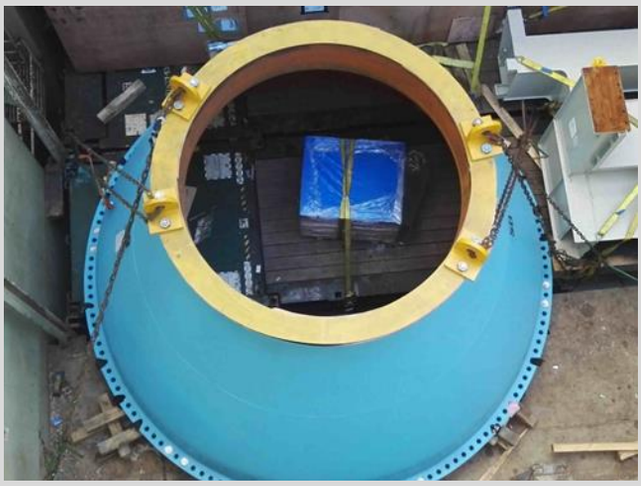




The packing method for each component (base seating for shaft cap and access pipe, lashing method, and lifting lug size) are calculated by the engineer to ensure its is cost effective and safe during the shipping process.

Flanges are protected by bolted plywood covers on each flange after application of slush oil and wrapping with oil impregnated Kraft paper for corrosion protection.

SHIPPING



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