1
0001,000 -- 0015,000
Today we're going to talk about corrosion control systems on construction projects. This is the seventh installment of the corrosion webinar series. My name is Jessica Torrey.
2
0015,000 -- 0028,000
I'm a materials engineer here at the TSC in the Materials and Corrosion Laboratory. I have several of my colleagues here from the Coating and Cathodic Protection team.
3
0028,000 -- 0048,000
First off, aside, we have a new name. We had a reorganization here at the TSC in Denver, and as of October 1st, we are now called the Materials and Corrosion Laboratory. Our org code is 8540. We used to be part of the Materials, Engineering and Research Lab, as many of you are familiar with.
4
0048,000 -- 0103,000
We are still housed in the same place, office is in the same place, everything is the same except for our name. Our supervisor in our group is Bill Kepler. We also got a few new members into our group.
5
0103,000 -- 0121,000
Our group now has advice and expertise for construction materials and reclamation facilities. Specifically, in the areas of protective coating, corrosion and cathodic protection, all American geosynthetic materials, composite materials.
6
0121,000 -- 0146,000
We now have Kevin Kelly in our group, who is in charge of environmental compliance and management. We also have several of our team members who are able to do special examinations on normally inaccessible features. This means that they are on the rope team and the dive team. We are able to offer those services to you for dive inspections or rope inspections.
7
0146,000 -- 0158,000
One of the key functions of our group, in addition to our work in design and construction and inspections, is to perform research related to all these areas.
8
0158,000 -- 0212,000
As I said, today we're going to talk about corrosion control systems. This means your protective coatings, or your cathodic protection systems. Specifically, as it relates to construction projects at reclamation.
9
0212,000 -- 0231,000
We're first going to go through a little bit of refresher and introduction to corrosion control systems. Talk about then our specifications. We'll go through our key components of our coating specifications as it relates to construction projects and all our cathodic protection systems specifications.
10
0231,000 -- 0258,000

We'll talk a little bit about training that's available for coatings and corrosion for cathodic protection inspectors. We'll talk about the role of an inspector, this is typically on reclamation projects, our CORs, and we'll talk about inspection tools and techniques and some common problem areas for you to look out for if you are one of these people who is doing the government inspection job.
11
0258,000 -- 0317,000
What is a corrosion control system? A coating, or protective coating, or paint is the primary defense against corrosion. Then we also in many cases, recommend cathodic protection and this works in conjunction with the coating to protect the structure and any defects that are in the coating.
12
0317,000 -- 0339,000
The most effective corrosion protection system for buried and submerged structure involves a good bonded coating and cathodic protection. If any of you have seen any previous webinars or taken our class here in Denver, you've probably heard us say this many times. We like to recommend a good bonded coating and the cathodic protection.
13
0339,000 -- 0352,000
A refresher on paints and coatings. There are several different types of paints. Architectural paints, which would be what you would use in your house. We also use a lot of concrete sealers for reclamation.
14
0352,000 -- 0409,000
What we're going to focus on today is our coatings for corrosion protection, and these are primarily barrier coatings, which control the penetration of water and ions to the underlying metal surface. They need to have a strong bond or strong adhesion to the substrate.
15
0409,000 -- 0430,000
These paints are typically composed of a binder, which is a polymeric material, a pigment and a filler, and then a solvent or something to dilute the coating for application. The types of barrier coatings, as I said, the types of protective coatings, barrier coatings are what we use most commonly here at reclamation.
16
0430,000 -- 0503,000
Some examples of these are coal tar enamel, polyurethanes, epoxys, vinyls. We also have sacrificial coatings. You see sometimes zinc-rich coatings and metallizing. For example, if you have galvanizing coatings on some of your steel structures. Then much less often, we see inhibitive coatings, which typically contain leads and chromates, and these are restricted materials, so we don't use them a lot on reclamation structures.
17
0503,000 -- 0520,000
A refresher on cathodic protection systems. This is a technique that we use to control corrosion by making the cathode of an electric chemical cell. In the case of galvanic anode cathodic protection, this is also known as sacrificial anode cathodic protection.
18
0520,000 -- 0534,000

We use the natural voltage difference between two metals. So we use one metal, for example a magnesium anode which you see here in the picture, to protect the second metal, which is the steel of the structure.
19
0534,000 -- 0546,000
And the second type of cathodic protection is called impressed current cathodic protection. This is where we use an external power source where the anodes are connected to the structure through a rectifier.
20
0546,000 -- 0600,000
If you need any more information on either the protective coatings or some basics on cathodic protection, we have some webinars that are available and we also have a training here in Denver that's available.
21
0600,000 -- 0618,000
This is an example of a corrosion control system where we have both the coating and the cathodic protection. As I said before, the coating is the main protective barrier and the cathodic protection protects the structure at defects in the coating.
22
0618,000 -- 0640,000
There’re four things that you will need for corrosion -- the anode, cathode, metallic return path, and the electrolyte. We can refer to this as our ACME, a little acronym to remember this. What the coating does is basically provides a barrier between the steel structure and the electrolyte.
23
0640,000 -- 0703,000
It breaks that pathway. What the cathodic protection does is assigns your anode to an external metal and assigns your structure as the cathode. You get your corrosion on the sacrificial anode or on the impressed current anode and you protect your structure.
24
0703,000 -- 0721,000
That was a little refresher on coatings and cathodic protections. Now we're going to dive right into the specifications. If you've read any of our coatings or cathodic protection specifications, they're fairly long. We don't have time to go through everything, but here on this page we will start out with our coating spec.
25
0721,000 -- 0745,000
You can see the typical headers of sections that are in our coatings spec. We do have a coating guide spec that's available on the website. These paragraphs here are typical, and we do tailor our coating spec to the type of project and the needs of the project.
26
0745,000 -- 0801,000
Specifically today, we're going to talk about two sections that you see highlighted in red. The submittal section, these are the things we want the contractors to send and have approved by staff here in Denver, typically our TSC coating staff.
27
0801,000 -- 0815,000

Then in the execution section, we're going to talk about our contractor field quality testing. This is where you'll see a lot of the language that deals with the inspection processes itself.
28
0815,000 -- 0842,000
Just a note on the coating specs, we do have separate spec sections for a lot of specialty coatings. So even though you see the O-99620, we will have a few different numerical designations if we have specialty coatings. For example, for concrete or pipelines, or vinyl and metallizing, they also have separate spec sections.
29
0842,000 -- 0907,000
In our submittal section, this is the information that we want the contractor to send to Denver, and that should be approved. Part of the job of the government inspector is going to be to make sure that the contractor is actually using the products that are approved through the submittal. The first submittal that we ask for is our approval data.
30
0907,000 -- 0926,000
This is where they send in either the brand name coating that's listed specifically in the coatings category section of the spec. They'll need to send the manufacturer's product data sheet, the application data sheets, and the MSDS data sheets for approval by TSC.
31
0926,000 -- 0956,000
If they are trying to use a coating product that's designated as an equal product to anything in the coating category, so a non-brand name product, there's a few additional pieces of information that's required. That's specifically showing where they've used this product successfully on similar types of products, again, all the manufacturer's certifications, as well as performance certifications for that product.
32
0956,000 -- 1008,000
Finally, if they're trying to match color or gloss of a specific paint, then they should send some paint chip samples as well.
33
1008,000 -- 1040,000
The next item for submittal is final approval data. This is where we get the information on the specific batch numbers of the coating that's purchased for this project. This allows us to go back if there's any problems with that coating. To go back, look at the batch numbers, and go to the manufacturer and try and figure out what's wrong. If we got a poor batch, or we got the wrong type of coating, and things like that.
34
1040,000 -- 1055,000
Next is the certification. We have two types of certification. First, we have the contractor's certifications. They need to be certified for the specific type of application that they're doing on a job, and the specific work that they're doing on a job.
35
1055,000 -- 1117,000
That could be for field application of that particular type of coating. Or hazardous materials removal, if we're doing that. Or for the shop application, if that's what's specified. Then we have manufacturer's

products certification. This could be things like a material's suitability for use with potable water.
36
1117,000 -- 1137,000
Finally, we have documentation. Which, this is where we show that each applicator, so each person who is applying the coating has training or experience for that particular type of coating. We ask for written evidence of that as a submittal.
37
1137,000 -- 1150,000
Then finally, the contractor quality testing data. This is all the information that a contractor's inspector will collect in the field.
38
1150,000 -- 1213,000
Next, we're gonna talk about the sub-section on contractor field quality testing. This is where we define how the contractor's qualified personal shall conduct the tests. This is often a third party inspector. They do have to and are required by the spec to perform these tests in the presence of the COR, the Contracting Officer's Representative.
39
1213,000 -- 1237,000
This would be the government's coating inspector. This person should be able to understand and recognize and know all of the tests that need to be done and be able to recognize if we're getting good results. Some of the key inspection points that are outlined in the sub-section...
40
1237,000 -- 1250,000
Prior to abrasive blasting, we need to be able to witness the general condition of the surface, for example. Compressed air quality, for example. General surface cleanliness.
41
1250,000 -- 1318,000
After abrasive blasting, the contractor should be testing for soluble salts, and primarily chloride. You can cause a lot of rust damage to a surface if they're not removed before the coating is applied. You need to test for surface profile. This would be using for example, surface comparators or replica tape. Again, surface cleanliness, to make sure that there's no residual blast media on the surface.
42
1318,000 -- 1336,000
After the final coat of material, again we're going to test for the dry-foam thickness. This should be tested for between each coat. If the spec requires three layers of coating, and after each of those three layers you'll want to test for the dry-foam thickness.
43
1336,000 -- 1351,000
As well, this is the point where you would do the continuity or holiday testing. Then finally, adhesion if it looks like there's problems with the coating. I have some examples and some pictures of these later on in the presentation.
44
1351,000 -- 1424,000
Spec also requires that inspection devices be furnished by the contractor to the government's inspector, if needed. Typically, the contractor's

inspector will be performing the test. The government's inspector is also able to perform these tests and can ask for those devices from the contractor. This might include a holiday tester, a DFT gauge, and then the certified calibration place or plastic shim.
45
1424,000 -- 1438,000
Then as well, in that section we talk about the contractor’s report. That should include things like the date of the work, description of the areas where the inspection was performed, and the work was performed.
46
1438,000 -- 1502,000
OK. So that's our coatings presentation, and you see that it's quite extensive and this is a very brief summary. Now, we're going to move into our Cathodic Protection Specification. This is specifically section 26-42-10. Although, as with the coatings, we typically can have multiple sub-sections in a spec package.
47
1502,000 -- 1523,000
For example, if we have different types of structures that we're protecting on a given project, because we have a pipeline and some tanks, and possibly some gates. Then each of those might have their own sub-section, and you would see it below 26-42-10, 26-42-11, etc.
48
1523,000 -- 1553,000
We do not have a guide spec for cathodic protection. Again, these paragraphs below are only typical. You may or may not see some of these in all specs. It will change based on the design for a project. We typically design each of our... and write out specs, particular to the design for that project. Again, we'll be talking about the submittal section, and the Contractor Field Quality section.
49
1553,000 -- 1614,000
For cathodic protection, the first submittal that usually comes to us in Denver, is the certification. We require a NACE Cathodic Protection Specialist Certification, what's also known as a CP4 certification, for the person performing our directing the installation.
50
1614,000 -- 1636,000
Not all of the people on site working with cathodic protection have to have the CP4, but there needs to be one person overseeing the job. Going through the drawings, approving the design, and things like that, who has the CP4 certification. We require that they submit that to us in Denver.
51
1636,000 -- 1657,000
We also ask for pre-construction drawings. A lot of the times we do the design and the drawings here in Denver, and then we often see the contractor just submit our own drawings back to us, but that's fine. That means that they've hopefully reviewed them and are going to go with our design.
52
1657,000 -- 1721,000
We also ask for manufacturers data sheets for system components. This is where we tend to reject a lot of submittals that come through our office.

We see a lot of times the contractor just isn't, for example, using the right cable, or doesn't have the proper weld material.
53
1721,000 -- 1747,000
This is where we see a lot of back and forth between us and the contractor. Then, where applicable, we ask them to submit any information on interference litigation. If there's other cathodic protection systems, or other pipelines in the vicinity of the project that we're constructing, then they need to submit their plan on how to mitigate that potential interference there.
54
1747,000 -- 1758,000
Then the next submittal that we see, is that final data. These are the actual as-built drawings, and any other pertinent information for how the test system was actually constructed. Then our testing data.
55
1758,000 -- 1818,000
That'll include testing equipment and any of the methods that they utilized, where they placed the reference electrodes for each of their tests, and then the results of these tests. These results should be in conformance with the NACE cathodic protection criteria for that structure.
56
1818,000 -- 1839,000
The contractor field quality testing, again this needs to be performed in the presence of the COR and is typically performed by the contractor's inspector. This might include energizing a system, adjusting that system, testing the cathodic protection system. This will depend on what type of system that we've installed.
57
1839,000 -- 1853,000
If it's the galvanic anode or impressed current system. Again, we specify that they need to confirm with COR prior to the testing. All the equipment must be provided by the contractor.
58
1853,000 -- 1908,000
We ask that they obviously record and report all their readings, and that comes through to us in a submittal. We ask that they, for example, for an Impressed Current System, that they conduct the testing in at least two cycles.
59
1908,000 -- 1929,000
This often takes some time for structures to polarize, so the values, the protective potentials, will be changing up to a certain point. We ask that they do this in two cycles so that they can do any troubleshooting or adjustments and correct the problems.
60
1929,000 -- 2005,000
These are as determined by the COR. The COR has the right to ask them to further adjust the system if necessary. They'll submit that final data after the last testing cycle when they have met the NACE performance criteria. We may require additional testing. We don't often do this. Hopefully they'll try and meet the NACE criteria and the systems are all designed to meet that criteria. There is an option that we can require additional testing if they don't meet our standard criteria.

61
2005,000 -- 2035,000
That's our spec sections. Now I'll talk a little bit about training that's available for inspectors. There's a number of professional certifications that are out there. These are pretty extensive courses that NACE, the National Association of Corrosion Engineers offers the Coding Inspector Program, the CIP Program. That has a level one and two, and then a peer review. Levels one and two are both one-week classes.
62
2035,000 -- 2051,000
Many of us here in Denver have these certifications. The peer review is actually sitting before a panel and basically answering questions as to your knowledge of coating application and inspection.
63
2051,000 -- 2113,000
SOPC, that is the Society for Protective Coating, also has a protective coating inspector program that has three levels. They also offer a non-certificate online training program that might be a place to pretty easily get some information fairly quickly because, as they say, this is a non-certificate program.
64
2113,000 -- 2147,000
On the cathodic protection side, again, NACE offers their CP program. There's four levels. The first three all begin with a T, and I never remember which one is which. Typically, you will hear us say CP 1, 2, 3 and 4. The CP 4 specialist certification, as I mentioned, is required for a person on the project. One of the contractor's specialists who is overseeing all the cathodic protection work.
65
2147,000 -- 2202,000
These are available, again the cathodic protection program, those are all one-week-long training, each of those levels. NACE is based out of Houston, so most of the trainings are in Houston, but they do offer them around the country on occasion.
66
2202,000 -- 2228,000
I think the CIP class, they try and have levels 1 and 2 once a year in Denver. There's one coming up here in April, although I got a notification that level 2 is cancelled, so they might just be doing the level 1 this year. Information on all of those are available at their website.
67
2228,000 -- 2256,000
In addition to any certification training, you'll always want to make sure that you have the proper training for on-site safety. Many of you are familiar with the certifications that are site-specific, such as fall protection, possibly I think you need rope access, confined space training -- permanent required confined space training, lockout/tagout program, now called the ETCP program.
68
2256,000 -- 2319,000
Be aware of the different hazards that can be on the job site and the protection that you're going to need. Certain weather conditions, for example. You never want to be out testing a cathodic protection system in a lightning storm. Even if it's 10 miles away, there's a chance for

pipelines of having a shock travel down those pipelines, so you want to be aware of that.
69
2319,000 -- 2331,000
Other physical hazards and possibly wildlife, for example, that might be on a project. Know your PPE. If you need safety shoes, your hard hats, helmets, frame protection.
70
2331,000 -- 2355,000
In all kinds of coatings jobs you can see Alan Skaija and I over here in our Tyvek suits or protective suits and our respirators getting ready to start an application on a coatings job -- a coatings repair for a cathodic protection installation -- so know what PPE you need and make sure you're safe on the job.
71
2355,000 -- 2359,000
We're going to move into the role of the coatings inspectors.
72
2359,000 -- 2403,000
[off-mic question]
73
2403,000 -- 2435,000
We have a question on who in TSB I think maybe has the certification. Everyone in our coatings group has either the NACE or SSPC certification so there's five of our staff and everyone has varying levels, but they all have inspector certifications.
74
2435,000 -- 2456,000
In our cathodic protection program three of us have the CP 3 level certification and then Chrissie is at CP 2 level, so we all have certifications here and just to throw that out, now while we're talking about it, we're all available to come as well as well as inspectors on jobs.
75
2456,000 -- 2501,000
Roger just retired, but he has a CP 4.
76
2501,000 -- 2521,000
Right. We just lost Roger Turcotte to retirement from our cathodic protection group and he was our CP 4 specialist. These are not easy certifications to get, and we are all trying for that CP 4 level, so hopefully a couple of us will be there before too long.
77
2521,000 -- 2537,000
Moving into the role of the coatings inspector. Just to clarify before we go further in this, there's typically two inspectors on the job site, and I want to make sure that we're all on the same page as to which inspector we're going to be talking about.
78
2537,000 -- 2552,000
We typically have the contractor's inspector. This is preferably a third-party inspector, although sometimes these are people that are hired by the contractor and then are actually staffed by the contractor.
79

2552,000 -- 2619,000
The contractor's inspector is a person or people that will perform all the testing and reporting required by the specification. They should be NACE or SSPC-certified and have experience that the particular type of infrastructure or equipment that's being coated, as well as the type of coating that's being used on the job. Having said that, that's ideal. It doesn't always happen that way, I think we all know that.
80
2619,000 -- 2642,000
The contractor shows up on the job with an inspector, and sometimes you just have to go with it, which is why it's so important to have the second inspector, which is the government inspector. This is typically a reclamation employee. It can be a member of our TSC staff who are available for these inspections. It could also be the COR, for example.
81
2642,000 -- 2701,000
This inspector will be observing all the tasks performed by the contractor's inspector. They may also conduct their own testing. If they see that something's not quite right, they disagree with the numbers that are coming out of the contractor's instrument, they can also perform their own testing.
82
2701,000 -- 2727,000
At a minimum, the government inspector should be familiar with each of the tests required by the spec. He should be able to recognize a good-versus-bad data reading. You should know all the requirements in the spec and know if your DST is meeting spec or not; and then be competent with the testing devices and know how to properly calibrate them.
83
2727,000 -- 2730,000
Are there questions?
84
2730,000 -- 2742,000
This next question is what certification would be best for government inspectors for both cathodic and coating?
85
2742,000 -- 2811,000
For cathodic protection the levels 1 and 2 are probably the best. Those are very heavily hands-on in the actual testing technique. I understand they are a long time commitment, but if you could get to CP 1 that would be great. As well for the coatings, I'm going to look at my coatings colleagues here, but the level 1 CIP training is very good.
86
2811,000 -- 2831,000
I've done that training just last year and it is also a lot of hands-on. It's a full day doing applications and using all these types of equipment and four other days doing classroom work. All of them have a one day exam at the end.
87
2831,000 -- 2858,000
I would say that, as an inspector, you could get the NACE level 1 or 2, and as a CP, a CP 1 or 2. Those would be great. We'd be happy to answer questions. As I said, many of us have been through those trainings so if you have specific questions on them, feel free to give us a call and we'd

be happy to go more in-depth as to what would be expected of those trainings.
88
2858,000 -- 2929,000
I would just add to that, that each of those trainings is gaining progressively more expertise and typically, that inspector will have progressively more experience. If you can get to the peer review level or the CP 4 level, that is essentially the point where you are deemed an expert -- somebody who can be hired independently to perform that role.
89
2929,000 -- 2957,000
Another really great training that you have the opportunity to get them. Some of the roles of our coatings inspector; number one, observe. Make sure you're there when the contractor's inspector doing all their tests. Watch the application process, make sure that they are applying coatings correctly. Take note of anything that he sees as out of the ordinary or out of spec.
90
2957,000 -- 3017,000
You can also test to verify the contractor's result if you deem that that's necessary, and then final and possibly the most important, verify performance to the specifications. That's the main role of the inspectors, to make sure that the contractor is meeting the requirements that are outlined in the specifications.
91
3017,000 -- 3040,000
Kind of common-sense, but why use the coatings inspector? It's to ensure that you are getting a good quality coating job. Contractors, I think all my colleagues have seen situations where they try and cut corners or do some crazy things. Having the coatings inspector on-site who's well trained will assure that you're getting that good product.
92
3040,000 -- 3105,000
Some of the risks that the inspector can help mitigate -- poor surface prep, poor coating application. I think one of our tips always is that 90 percent of the coatings job is in the surface preparation, 10 percent are something in the application. Make sure that these steps are followed through with in a proper manner.
93
3105,000 -- 3122,000
If they're not, you can have reduced coating service life, or premature coating failure, which is bad, but then the worst-case scenario, this leads to poor protection of your structure. You actually start losing metal off your structure. That's something that we don't want to be seeing.
94
3122,000 -- 3133,000
These are things that your inspector can help to ensure that you get a good product, so that you are having good protection of your structure for the long-term.
95
3133,000 -- 3204,000
We kind of went through some of these in the spec section. Here's our critical stages of coating inspection, and some photos that you can see,

for example, surface cleanliness and profile. You can see here, there's some pitting that remains on the surface. Ideally, this would be removed or filled, before you have the coating application. Here's one of our staff using a replica tape to get a profile of this coating repair section.
96
3204,000 -- 3221,000
You can use something like this, profile comparators. Just make sure that you have a good enough angularity on your surface to get a good mechanical bond of your coating, and good adhesion of your coating.
97
3221,000 -- 3247,000
Here's an image of a soluble salt test. This tests specifically for chloride on a surface. There's a kit that you can buy. You put some liquid in here. Rub this onto the surface. There's a glass tube that I have. In one of the following slides, you'll be able to see that. With a sponge in it, it'll pull up that liquid. It will tell you if you have chlorides on your surface.
98
3247,000 -- 3258,000
If chlorides remain underneath the coating, you can have some pretty serious problems with rust and premature rusting through your coating.
99
3258,000 -- 3331,000
Next is checking for thin spots. Make sure that the contractor does a stripe coat. You can see in these images here, in the lower left corner, there's some pretty complex geometries here, welds for example. You also would like to see stripe coats over any crevices that you might have. You'd want them to be filled before your coating application, just to make sure that they are meeting the coating thickness requirements in these hard-to-coat areas.
100
3331,000 -- 3348,000
You would test that by doing a dry film thickness measurement, a DFT measurement, after each coat. As I said before, a spec requires two, three, four layers of a coating, then you would want to do that after each layer, and confirm your DFT.
101
3348,000 -- 3420,000
Finally, this is one example of a tool for doing holiday testing. You moisten the sponge. Run it over a surface. With the electrical connection, it usually gives an audio, little beep, for example, if they find a pinhole in your coating. These are some examples of critical stages of your inspection. We'll go just a little bit more into that.
102
3420,000 -- 3443,000
Testing tools and techniques. On your surface prep side, one of the big things we can see problems with, is the contractor fails to properly protect adjacent surfaces and equipment. You could get splatter or misting of your coating as it's being applied to incorrect locations.
103
3443,000 -- 3504,000
You want to make sure they're taking measures to prevent that. At sharp edges or irregular surfaces and pits, you want to make sure that they're

grinding these out and removing these. They can cause further problems if you coat them without proper surface preparation.
104
3504,000 -- 3520,000
General surface cleanliness. You want to make sure that after they do the abrasive last step, that they then clean the surface so that it's free of the blast media. You want to make sure that before they coat, that there's no rust or other visible contaminants on the surface.
105
3520,000 -- 3539,000
Those could be, if they have certain weather conditions where they could get flash rusting, for example. They blast it and maybe leave it overnight, and then the next morning come in and want to coat, but there's some rust on the surface.
106
3539,000 -- 3601,000
You want to make sure that they don't start coating over that. If there's oil, grease, or contaminants like this as well, point those out. As I mentioned before, that soluble salt contamination, and over here on the right, in the blue, these two little glass tubes here are examples of what the test kit look like.
107
3601,000 -- 3622,000
You would put the liquid in here. Rub that onto the surface for certain amount of time. Then insert one of these tubes with the tip broken off. The liquid gets sucked up into the tube. Based on where this color change happens, will indicate the presence of chlorides on your surface, and how much chlorides you have on your surface.
108
3622,000 -- 3638,000
There's ranges where you want to make sure that you don't go higher than certain levels of chlorides. If we do find this, then they need to clean the surface again, and remove those chlorides before they do their coating.
109
3638,000 -- 3702,000
We mentioned surface profile. There's a bunch of images down here in the lower left on surface profile. Each type of coating typically has a target ml profile. I'm not saying that correctly. You might say that this coating needs 2.5 ml profile.
110
3702,000 -- 3719,000
What we mean by that is this kind of angularity, the distances between peaks and valleys on your metal surface before you apply the coating. You really need that to get a good mechanical adhesion of your coating to the surface.
111
3719,000 -- 3746,000
One of the ways to test that is with this tape, a replica tape. This one happens to be brand name Testex. You can buy these in little rolls. You stick this onto your surface. Use one of these little ball-peen tools that come with the tape. Rub that on there. Then use the micrometer to measure that profile. Confirm that profile.
112

3746,000 -- 3821,000
In the specs, there's many different standards that are listed for each of these surface conditions. This is a SSPC booklet that you can get as a comparative tool for surface profiles. There's one, for example, your rust condition on your surface, cleanliness. All that information is included in the specification. An inspector should be familiar with those different standards that are available, what standard is called out.
113
3821,000 -- 3852,000
For example, in some cases you might only need this SP2 surface finish, probably not, but [laughs] if that's called out in the spec, than you want to make sure that that's met, whereas, a lot of times, you're down here more on a white metal blast, or something where you see little very rust and contamination on the surface. It looked like a very clean surface before they start coating.
114
3852,000 -- 3902,000
You want to make sure you know which of those standards is called out in the spec, and then that the contractor meets those standards.
115
3902,000 -- 3924,000
Moving on to inspection tools and testing for the application process -- there's certain environmental testing that you should be doing, or that you should be observing the contractor do before they coat -- for example, your ambient and surface temperatures, the surface temperature of the structure, the relative humidity, the dew point, and the wind speed.
116
3924,000 -- 3934,000
Many coatings have specific requirements that they cannot be applied unless environmental conditions meet certain requirements.
117
3934,000 -- 3956,000
Your dry film thickness testing, this should meet the specs for a chosen coating product. Your spec will say something like, "We need coat number one to meet 6 ml to 8 ml thickness. The final DFT should be retained, 18 and 20 ml," or something like that.
118
3956,000 -- 4033,000
You want to be familiar with what's in the spec, and then make sure that the contractor meets those DFTs. You should try and focus on difficult-to-coat areas like some of those corners, edges, or where they have welds, for example. Make sure that they're doing their stripe coats and fillers. Make sure that they meet that DFT in all these difficult areas, and that they're using filler materials on things such as rivets, seams, they have skip welds, any irregular surfaces, pits, crevices, etc.
119
4033,000 -- 4054,000
There's also some other things that the inspectors should be checking on. These include things like recoat windows, making sure that the contractor's not exceeding the recoat window for a given coating product, looking for other coating defects, things like amine blush, off ratio application, contaminants, etc.
120
4054,000 -- 4133,000

The final inspection, you want to go and confirm the DFT, and pay special attention to those difficult-to-coat areas. The final inspection is where the contractor inspector will be doing the holiday testing, looking for any pinholes in the coating. Look for any signs of visible damage, for example, over here there's some sags or drips in the sealing of a pipeline. Look for things like that, runs, sags, blisters.
121
4133,000 -- 4154,000
If there is potentially a problem, you might ask for an adhesion test to be performed. These are -- you can't see the backside -- but it's a little metal dolly that specifically gets glued to a surface, and then pulled straight off. You see in this case, that the adhesion was very poor on this particular coating.
122
4154,000 -- 4208,000
Certainly, if you see indications like this where you would already have rust starting, for example, at rivets or at crevices, or you've noticed that they haven't filled in those areas.
123
4208,000 -- 4230,000
Finally, you want to make sure that the coating is not put into immersion service until it's fully cured. There are underwater cure coatings, but most of the coatings require a certain amount of cure time, in the atmospheric, ambient conditions. Make sure the temperature requirements for that cure are met until they put that in service.
124
4230,000 -- 4251,000
Moving on into the cathodic protection inspector, very similar to the coating, that reclamation's PC inspector is typically the project COR. We're also trained and available at the TSC to come and be inspector for cathodic protection systems on your job site.
125
4251,000 -- 4310,000
The role is to observe the installation and the testing of the cathodic protection system. This testing should be performed by the contractor's inspector. Verify that only approved materials are installed. One of the "biggies" that we always see is that contractors try and use the improper cable for burial.
126
4310,000 -- 4335,000
There's very specific cable that's allowed for cathodic protection systems, both in the gauge and the sheathing on that cable, especially if it's meant for burial service, so much more expensive than what you would typically use for atmospheric exposure. We see often incorrect cable being used.
127
4335,000 -- 4352,000
The COR and government inspector's job is to approve any troubleshooting that's required or defer this to the TSC staff for approval of any changes or troubleshooting that needs to be made with this CP system.
128
4352,000 -- 4415,000
As we said for the coatings of CPs, inspector doesn't typically perform the testing themselves, rather they observe the testing that's performed

by the contractor's hired inspector. This is both during energizing a system, and testing a system. These results all have to be submitted to the TSC by the contractor.
129
4415,000 -- 4436,000
Benefits of the knowledgeable inspector are assurance that you're getting a quality product, assurance that your CP system is adequately protecting your structure. You don't want to install a system, and spend all that money and time to install the system, and then not have it meet protection criteria.
130
4436,000 -- 4502,000
Tools for the CP tests. Some of those things that you want to make sure that the contractor has the proper tools for, are...Typically we use copper-copper sulfate reference electrode when we're testing cathodic protection systems. You can see a picture of that in the upper-right. You should make sure that the contractor calibrates this to an electrode that is not used in the field.
131
4502,000 -- 4531,000
We typically have one that we call our truck electrode. It stays in our truck. It doesn't get used. Every day we calibrate to that electrode. Your field electrode should be within 5 mV. That's considered stable. If that doesn't meet that, then they should re-prepare the electrode. Dump out the solution. Use distilled water. Make sure that there's solid crystals that are remaining in the electrode, visible through that window.
132
4531,000 -- 4554,000
The second common piece of testing equipment for CP is your portable voltmeter. The big thing here is that you want to make sure it has a minimum impedance of 10 mega-ohms. Some of the less expensive, typically also smaller, multimeters that you would buy at a hardware store, for example, don't have this input impedance.
133
4554,000 -- 4608,000
They can actually affect the measurement, because the circuitry inside the device itself, does not have enough impedance to give you accurate measurements of only your system.
134
4608,000 -- 4619,000
In the middle here, photographs, those are two examples of...these happen to be Fluke multimeters here in our lab.
135
4619,000 -- 4641,000
Finally, if you're working with an impressed current system, especially for pipelines, then you'll have to interrupt the current to do the testing. On pipelines, you want to make sure that if there are multiple rectifiers on a system, that all the rectifiers affecting that area are interrupted simultaneously.
136
4641,000 -- 4656,000
This is really easy to do now. They have GPS-synchronized, time-synchronized interrupters. You set two or three of them on the pipeline, and then you test the test stations in between them.

137
4656,000 -- 4722,000
During installation, things that you might want to look out for as an inspector are the metallurgical bonds -- you can see an example up there in the upper left -- like thermal welds, or CADWELDs. Typically, you'd want to make sure that someone does a hammer test on these. Basically, it is what it says. If you hit it with a hammer, and if it doesn't pop off, it's a good weld.
138
4722,000 -- 4748,000
The other two things are electrical continuity and electrical isolation. In the other photograph, you can see kits for a flange or a joint, where you would have isolation gasket, as well as the bolts are isolated, so that you do not have continuity across that joint or flange. In some cases, you want continuity.
139
4748,000 -- 4806,000
You want to make sure that you're familiar with what the spec calls for at that location, if they require isolation, that they're doing an isolation test once they've installed it, to make sure that that's what they're getting.
140
4806,000 -- 4824,000
On a galvanic anode system, for example, on gates if you have a direct melted anode, you want the anode as welded to the structure. Typically, you can use your multimeter, and just test between the anode and the structure. Make sure you have good continuity there as well.
141
4824,000 -- 4840,000
Once you're ready to energize your system and test your system, you want to test to make sure it's meeting the NACE criteria for protection. The big one here is your polarized potential, also known as your instant-off potential.
142
4840,000 -- 4901,000
For example, for steels, the NACE criteria is that it either must meet the -850 mV -- this is using a copper sulfate reference electrode, or more negative -- or it must meet a minimum 100 mV shift more negative from the native potential.
143
4901,000 -- 4918,000
At Reclamation, here at the TSC, we also recommend the system not be energized more negative than -1100 mV to a copper sulfate electrode, in order to avoid things like damaging your coating.
144
4918,000 -- 4940,000
That right there, that paragraph, it's like a whole day training, [laughs] typically, in our CP classes. We do have a webinar that's available on cathodic protection system training, where we go a lot more in-depth into those criteria. There is resources available if you want more information about that.
145
4940,000 -- 5012,000

The other things that you typically see a contractor testing for in certain types of systems are the current output from each anode. For example, there's a junction box over here. Each of these dials is a variable resistor. Each of these lines here is a shunt. They can actually test across the shunts to get the current output from each anode, and then use the variable resistor that corresponds to that anode, to adjust the current output, if necessary.
146
5012,000 -- 5029,000
They'll also need to report rectifier settings, and any adjustments that they make to the system, if they go through and test and they do not meet the test criteria, they should record if they've, for example, turned up or turned down the rectifier, things like this.
147
5029,000 -- 5043,000
Finally, this is our last slide, so as well as all of the certification training offered by these professional societies, such as NACE and FSPC, we have some TSC-sponsored training.
148
5043,000 -- 5108,000
We have a three-day Coatings and Corrosion School, which takes place in Denver, typically once a year. We haven't set a date for the next one yet. This is lectures and hands-on training. It takes place here in our Coatings and Corrosion labs. We also have these webinar series twice per year, typically in the February-March timeframe and the June-July timeframe, depending on what my schedule is.
149
5108,000 -- 5131,000
You can email me. There's my email address. I'll put you on the mailing list. You'll get any further notices on the webinars. There’re the names. We now have seven webinars available, once I get this one processed, captioned, and up on the website. Those are available. That final bullet is our TSC training website.
150
5131,000 -- 5203,000
As I said, right now, it's only on the intranet site, which means only DOI employees can access that. But hopefully very soon it will be pushed to the Internet site, and then it's available as well to those of you outside. That link will get you to the PDF of the slides, as well as videos of all the corrosion website. Finally, thank you for your attention, here's all of our TSC coating and corrosion staff.