Chlorides and Salts, Inspection and Sampling

MONTIPOWER
DEFELSKO
EXTECH
TINKER-RASOR
WESTERN INSTRUMENTS

G.A.L.
MAGNALIGHT
DAKOTA
MAGNALIGHT
TQC

281-359-2215

POTENTIAL CAUSES OF COATINGS FAILURES

- Poor applicator training
- Poor quality control
- Lack of qualifications by sub-contractor
- Lack of facilities to adjust environment
- Unsafe conditions
- Non-user friendly coatings system
- Prime in shop - Finish in field
- Specification non-compliance
- Improper surface preparation

COATINGS FAILURES (CONT.)

- Recoat too quickly
- Recoat to Slowly
- Lack of catalyst
- Wrong catalyst
- Improper mixing
- Lack of induction
- Improper storage
- Out of potlife
- Improper design
- Not enough millage
- Last in cycle
- Excessive profile
- Improper media
- Poor equipment maintenance
- Wrong thinners
- Improper additives
- Water in lines
- Oil in lines
- Out of shelf life
- Excessive millage
- Personnel turnover
- Concealed areas

COATINGS FAILURES (CONT.)

- Lack of time
- Poor paint quality
- Limited people
- Hoses too long
- Low air pressure
- Keep on trucking
- Language barrier
- Wrong product for service
- Lack of disclosure
- Resistance to change
- Too long between surface preparation and prime
- Surface contamination

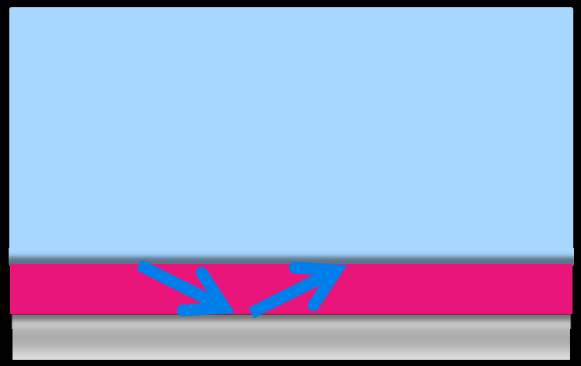
Question

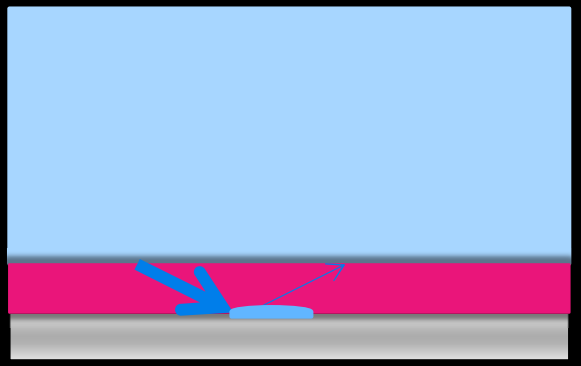
People worry about Chlorides because they contribute more to osmosis than other Ions.

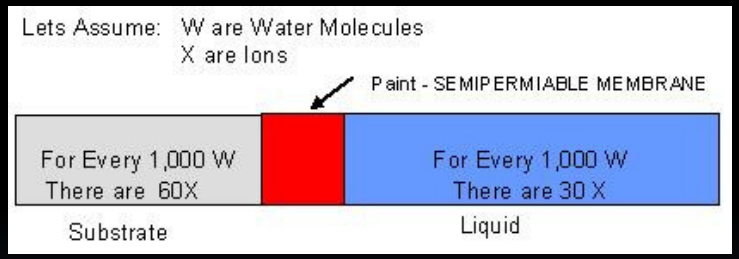
A. TRUE

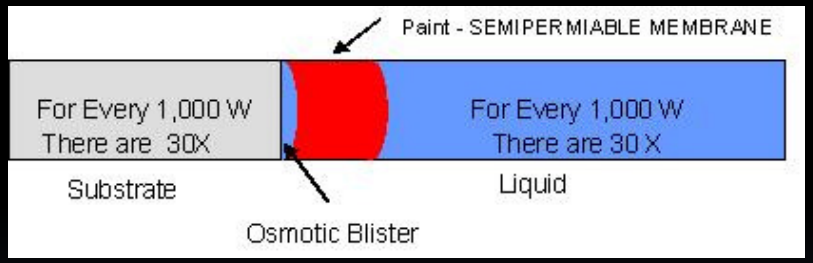
B. FALSE

OSMOSIS









Nature wants everything to be in balance and will do whatever is necessary to restore that balance. There are Twice as many X's or Ions on the left side of the membrane as the right side.

To balance things out you can move 15 X's from the left side to the right side. Unfortunately, the X's or ions will not go through the membrane so it must balance it out moving the water which will go through the membrane. To balance things out, 1,000 W's must go through the membrane for every 60 X's to balance it out.

Since there is not enough room for the water, it pushes up on the paint and causes a blister.

OSMOSIS

Osmosis is a property of the Solution. The only thing that matters is how many ions are present and not what the ions are.

The STUFF the solution is composed of is NOT IMPORTANT. It is just a numbers game.

What is important is not what the salt is but how SOLUBLE the salt is and how many IONS it contributes to the SOLUTION.

Anything that dissolves to form a solution will cause Osmosis including Sugar and Solvents.

OSMOSIS

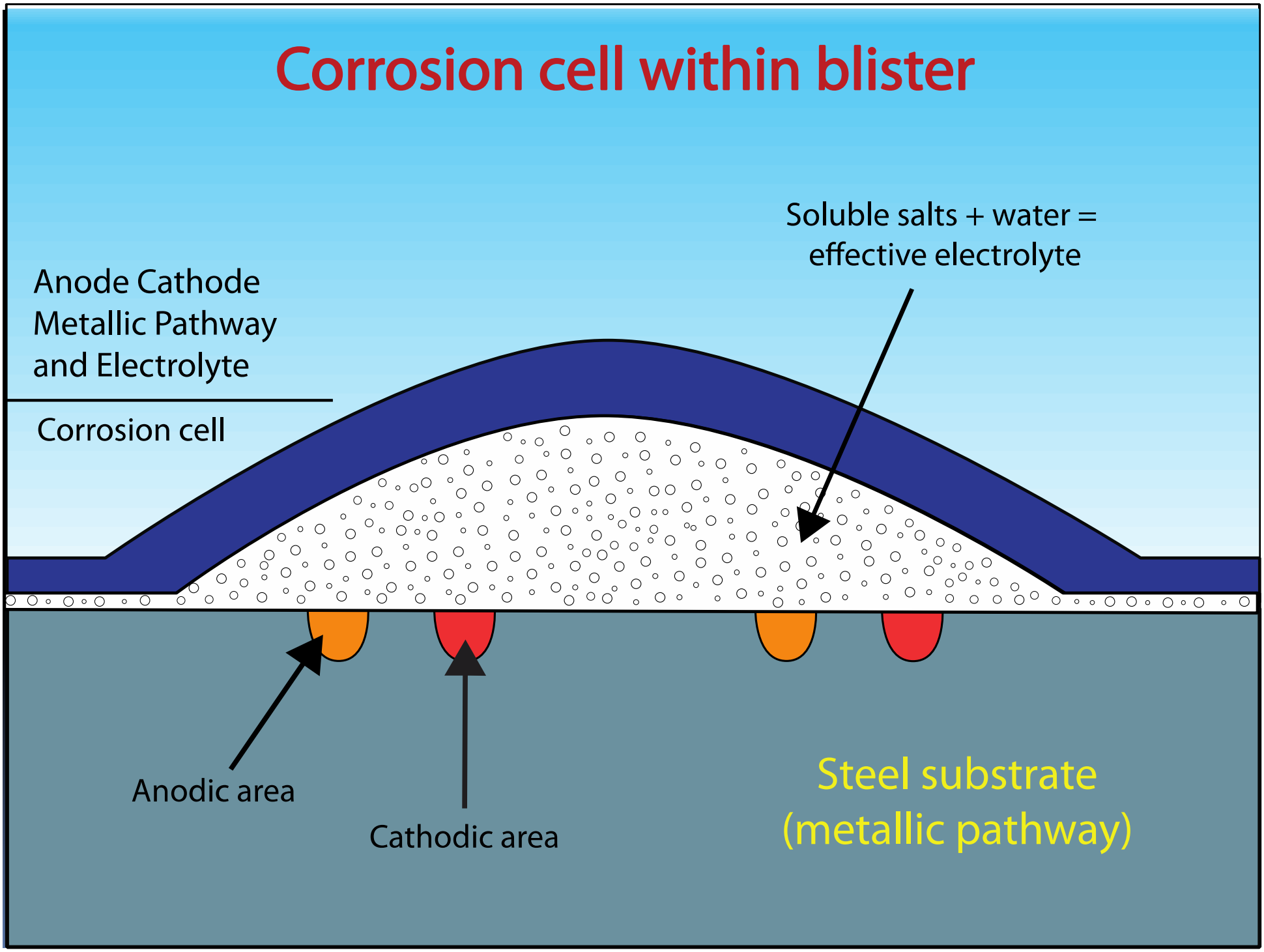
DISCLAMER:

Paint is not a true semi permeable membrane

Coatings in immersion service typically have 1% to 3% water tied up in its matrix

How Osmosis works changes as the concentration of the solution changes. For our purposes the previous description works

Corrosion cell within blister



Surface Cleanliness Standards

Coating performance is dependent on surface preparation and cleanliness

Visual standards pertaining to **flash rust**:

- **ISO 8501-1**
  - Sa 2 1/2: *Very Thorough Blast Cleaning*: "…Any remaining traces of contamination will show only as slight stains in the form of spots or stripes."
  - Sa 3 is more stringent: "…It shall have a uniform metallic color"
- **SSPC and NACE** Joint Preparation Surface Standard for waterjet cleaning of bare metals … The visual conditions of surface cleanliness are:
  - SSPC-SP WJ-1/NACE WJ-1 - *Clean to Bare Substrate*
  - SSPC-SP WJ-2/NACE WJ-2 - *Very Thorough Cleaning*
  - SSPC-SP WJ-3/NACE WJ-3 - *Thorough Cleaning*
  - SSPC-SP WJ-4/NACE WJ-4 - *Light Cleaning*

Some Representative Salt Limit Guidelines

- US Navy immersed maintenance coating max 50mg/m² (5µg/cm²)
- Shell International old steel maintenance max 50mg/m² (5µg/cm²)
- Shell International new steel painting max 25mg/m² (2.5µg/cm²)

Currently, there is not an industry standard for salt limits and typically is determined by coating manufacturer or asset owner

Question

The specification calls for Total Salts to be less than 20 μg/cm^2. It is OK to use the Sleeve Test to test for total salts.

A. TRUE

B. FALSE

Question

Can you use the CSN kit to test for total Salts?

HINT: CSN is Chlorides, Sulfates, Nitrates

Common Anions:

Simple ions:			
Hydride	H^-	Oxide	O^{2-}
Fluoride	F^-	Sulfide	S^{2-}
Chloride	Cl^-	Nitride	N^{3-}
Bromide	Br^-		
Iodide	I^-		
Oxoanions:			
Arsenate	AsO_4^{3-}	Phosphate	PO_4^{3-}
Arsenite	AsO_3^{3-}	Hydrogen phosphate	HPO_4^{2-}
		Dihydrogen phosphate	$H_2PO_4^-$
Sulfate	SO_4^{2-}	Nitrate	NO_3^-
Hydrogen sulfate	HSO_4^-	Nitrite	NO_2^-
Thiosulfate	$S_2O_3^{2-}$		
Sulfite	SO_3^{2-}		
Perchlorate	ClO_4^-	Iodate	IO_3^-
Chlorate	ClO_3^-	Bromate	BrO_3^-
Chlorite	ClO_2^-		
Hypochlorite	OCl^-	Hypobromite	OBr^-
Carbonate	CO_3^{2-}	Chromate	CrO_4^{2-}
Hydrogen carbonate or Bicarbonate	HCO_3^-	Dichromate	$Cr_2O_7^{2-}$
Acetate	CH_3COO^-	formate	$HCOO^-$
Cyanide	CN^-	Amide	NH_2^-
Cyanate	OCN^-	Peroxide	O_2^{2-}
Thiocyanate	SCN^-	Oxalate	$C_2O_4^{2-}$
Hydroxide	OH^-	Permanganate	MnO_4^-

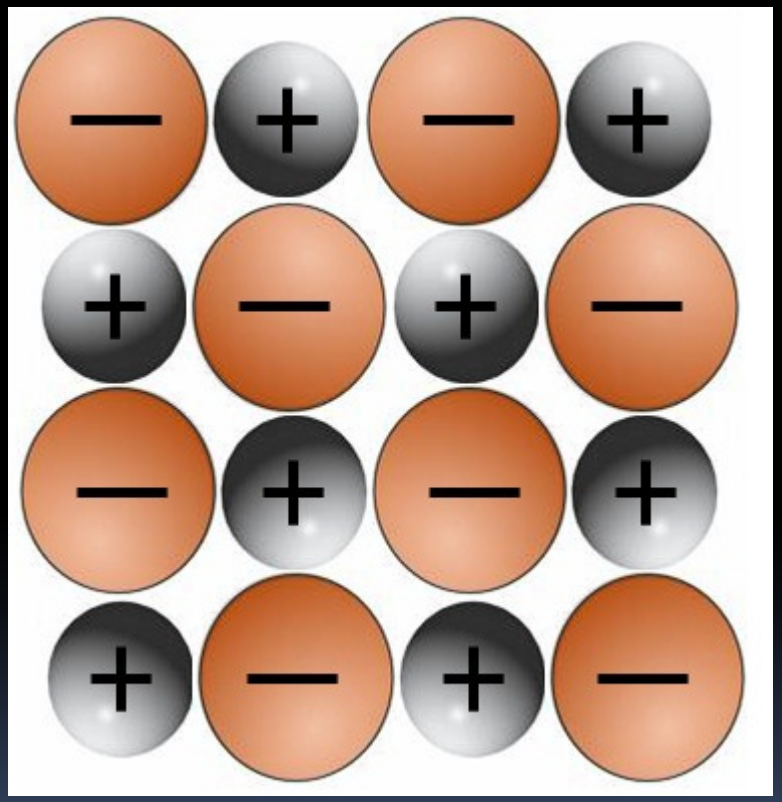
Common Cations:

Name	Formula	Other name(s)
Aluminum	Al^{+3}	
Ammonium	NH_4^+	
Barium	Ba^{+2}	
Calcium	Ca^{+2}	
Chromium(II)	Cr^{+2}	Chromous
Chromium(III)	Cr^{+3}	Chromic
Copper(I)	Cu^+	Cuprous
Copper(II)	Cu^{+2}	Cupric
Iron(II)	Fe^{+2}	Ferrous
Iron(III)	Fe^{+3}	Ferric
Hydrogen	H^+	
Hydronium	H_3O^+	
Lead(II)	Pb^{+2}	
Lithium	Li^+	
Magnesium	Mg^{+2}	
Manganese(II)	Mn^{+2}	Manganous
Manganese(III)	Mn^{+3}	Manganic
Mercury(I)	Hg_2^{+2}	Mercurous
Mercury(II)	Hg^{+2}	Mercuric
Nitronium	NO_2^+	
Potassium	K^+	
Silver	Ag^+	
Sodium	Na^+	
Strontium	Sr^{+2}	
Tin(II)	Sn^{+2}	Stannous
Tin(IV)	Sn^{+4}	Stannic
Zinc	Zn^{+2}	

Question

SALTS ARE MOLECULES

A. TRUE
B. FALSE



$$Na + Cl \rightarrow Na^{+} + Cl^{-} \rightarrow NaCl$$

Question

The specification calls for Chlorides to be less than 20 µg/cm^2. Is it OK to use a Conductivity to test for Chlorides.

A. TRUE
B. FALSE

Question

A fast, cheap and easy way to measure Chlorides is to use Potassium Ferricyanide Test Papers which turn blue in the presence of chlorides.

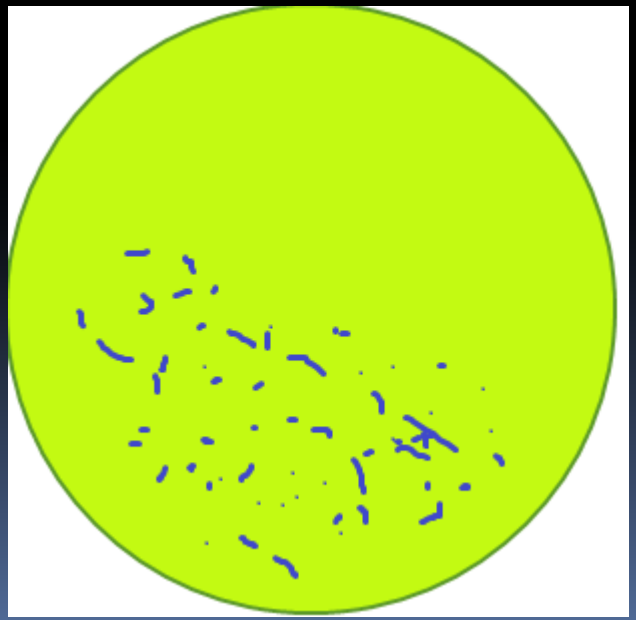
Question

What test do you run to not find Soluble Salts?

Anwser

Potassium Ferricyanide does not react with Chlorides – It reacts with Fe++. Since the Cation does not exist without the Anion, it means salts are present. Since chlorides readily react with iron and are the most common anion, it is probably chlorides but can also be any other iron salt

Low Cost
Quick
Very Sensitive



Is it better to test for Chlorides or Conductivity

IT DEPENDS ON THE SPECS

They are both "accurate" for what they are measuring. They just are not measuring the same thing.

It is generally recognized that no salt test or chloride test is 100% accurate.

ISO, IMO, NACE, SSPC & the Navy are all trying to determine a standard and have settled on Conductivity.

Standard is for CONSISTANCY - NOT NECESSARILY ACCURACY

TEST	Cost per Test	Time	TOTAL (Soluble) SALT
Sleeve Test	$20.00 per test	10 minutes per test	NO
MTest Chloride Test Kit Initial cost of $250.00 (10 Tests)	$15.00 per Test	10 minutes per test	NO
CSN TEST Initial cost of $999.00 (5 TESTS)	$35.00 per test	15 – 20 minutes per test	NO
Patch Test Initial Investment of $530 (25 tests)	$5.00 per test	5 – 10 minutes per test	YES
DeFelsko Posipatch Initial Investment of $715 (50-75 tests)	$0.50 - $1.00 / test	5 -10 min per test	YES
SCM Salt meter Initial investment of $5,900.00 (100 Tests)	$1.29 per test	2 to 3 minutes per test	YES
SSM meter Initial investment of $5,975.00 or $2,495	Minimal/$6.50 per test	1 minute per test	YES
Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

Sleeve Test

sleeve Test	$20.00 per test	10 minutes per test

TEST	Cost per Test	Time	TOTAL (Soluble) SALT
Sleeve Test	$20.00 per test	10 minutes per test	NO
MTest Chloride Test Kit Initial cost of $250.00 (10 Tests)	$15.00 per Test	10 minutes per test	NO
CSN TEST Initial cost of $999.00 (5 TESTS)	$35.00 per test	15 – 20 minutes per test	NO
Patch Test Initial Investment of $530 (25 tests)	$5.00 per test	5 – 10 minutes per test	YES
DeFelsko Posipatch Initial Investment of $715 (50-75 tests)	$0.50 - $1.00 / test	5 -10 min per test	YES
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Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

Mtest Chloride Test Kit

COST PER TEST = $15.00

TEST	Cost per Test	Time	TOTAL (Soluble) SALT
Sleeve Test	$20.00 per test	10 minutes per test	NO
MTest Chloride Test Kit Initial cost of $250.00 (10 Tests)	$15.00 per Test	10 minutes per test	NO
CSN TEST Initial cost of $999.00 (5 TESTS)	$35.00 per test	15 – 20 minutes per test	NO
Patch Test Initial Investment of $530 (25 tests)	$5.00 per test	5 – 10 minutes per test	YES
DeFelsko Posipatch Initial Investment of $715 (50-75 tests)	$0.50 - $1.00 / test	5 -10 min per test	YES
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CSN TEST

CSN TEST	$35.00 per test	15 – 20 minutes per test

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MTest Chloride Test Kit Initial cost of $250.00 (10 Tests)	$15.00 per Test	10 minutes per test	NO
CSN TEST Initial cost of $999.00 (5 TESTS)	$35.00 per test	15 – 20 minutes per test	NO
Patch Test (Bresle Test) Initial Investment of $530 (25 tests)	$5.00 per test	5 – 10 minutes per test	YES
DeFelsko Posipatch Initial Investment of $715 (50-75 tests)	$0.50 - $1.00 / test	5 -10 min per test	YES
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SSM meter Initial investment of $5,975.00 or $2,495	Minimal/$6.50 per test	1 minute per test	YES
Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

Patch Test

Patch Test	$7.00 per test	5 – 15 minutes per test

TEST	Cost per Test	Time	TOTAL (Soluble) SALT
Sleeve Test	$20.00 per test	10 minutes per test	NO
MTest Chloride Test Kit Initial cost of $250.00 (10 Tests)	$15.00 per Test	10 minutes per test	NO
CSN TEST Initial cost of $999.00 (5 TESTS)	$35.00 per test	15 – 20 minutes per test	NO
Patch Test Initial Investment of $530 (25 tests)	$5.00 per test	5 – 10 minutes per test	YES
DeFelsko SST Posipatch Initial Investment of $715 (50-75 tests)	$0.50 - $1.00 / test	5 -10 min per test	YES
SCM Salt meter Initial investment of $5,900.00 (100 Tests)	$1.29 per test	2 to 3 minutes per test	YES
SSM meter Initial investment of $5,975.00 or $2,495	Minimal/$6.50 per test	1 minute per test	YES
Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

DSeFelsko SST

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Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

SCM Salt Meter

130 Salt meter

$1.29 per test

2 to 3 minutes per test

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SCM Salt meter Initial investment of $5,900.00 (100 Tests)	$1.29 per test	2 to 3 minutes per test	YES
SSM meter - Parks - Hederon Initial investment of $5,975.00 or $2,495	Minimal/$6.50 per test	1 minute per test	YES
Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test	YES*

*Salts that react with Iron

Soluble Salt Meter (SSM)

SSM meter

Minimal

1 minute per test

TEST	Cost per Test	Time	TOTAL (Soluble) SALT
Sleeve Test	$20.00 per test	10 minutes per test	NO
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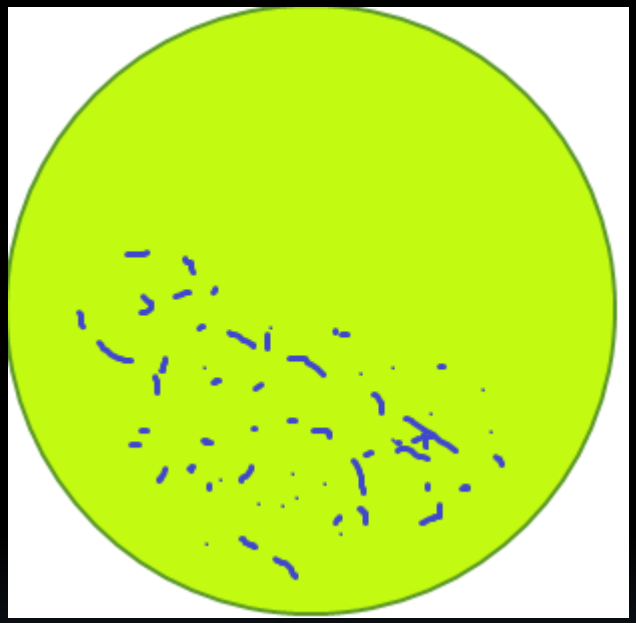
Potassium Ferricynide Paper



Potassium Ferricyanide Paper	$0.25 to $0.50 / test	30 seconds per test

NST Salt Meter - Discontinued

NST Salt Meter $17.00/test 10 minute wait - 1 minute per test

Question

Your limit is 7 μg/cm² Total Salts. You run a Patch test in accordance with the test directions and get 35 mg/m2. Are you OK to paint.

A. TRUE

B. FALSE

Question

Your limit is 7 µg/cm² Total Salts. You run a Patch test in accordance with the test directions and get 35 mg/m2. Are you OK to paint.

A. TRUE

B. FALSE

To get µg/cm² multiply by 0.1 so = 3.5 µg/cm²

RUNNING BLANKS

Prior to running the tests, check the conductivity of the reagent water. The water will probably have some conductivity and if it is good water should be between 0.5 to 3 μS/cm Subtract this number from the conductivity of the tested water.

If the test is close to the limit – run a blank Patch test on a clean surface (generally glass if available). The Patch generally contributes SOME conductivity to the test, however if using Branded Patches, this should be minimal but could cause a failure if the test is close or if you are using a cheaper imitation patch.

Number of Tests and Where to Test

Follow the specs. The Navy and IMO have some guidelines for marine service but there are no good guidelines for general industrial painting.

I believe there are too may variables to come up with a standard for all types of projects

Use common sense and get agreement with all parties involved prior to testing.

SUMMARY INVISIBLE CONTAMINATS

- No Field test measures all the salts or chlorides on the surface
- Flash Rusting is a sign Salts/Chlorides may still be present
- There is no “Magic Number”. Follow the specs or coating manufacturers recommendation
- Most Specs are overly conservative

What test do you run if you DO NOT want to find all of the soluble salts?

- A - C SN test

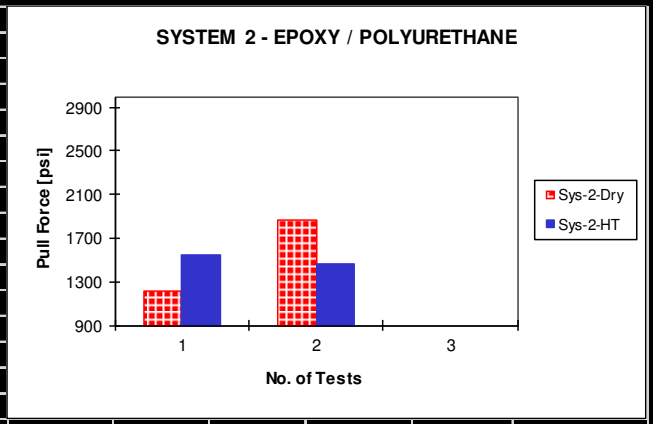
What test do you run if you want to find all of the soluble salts?

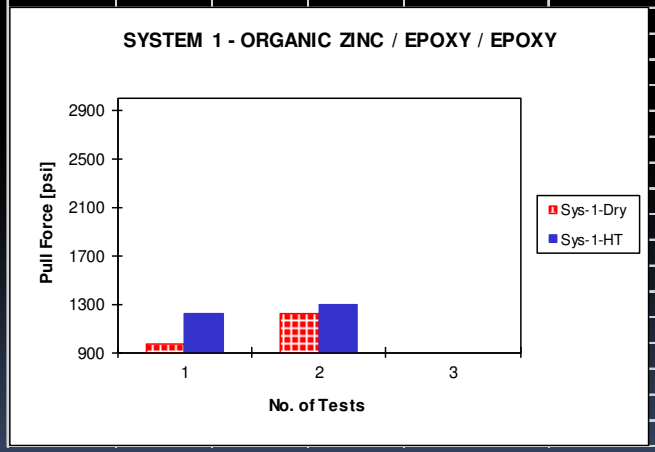
- Any of the conductivity methods

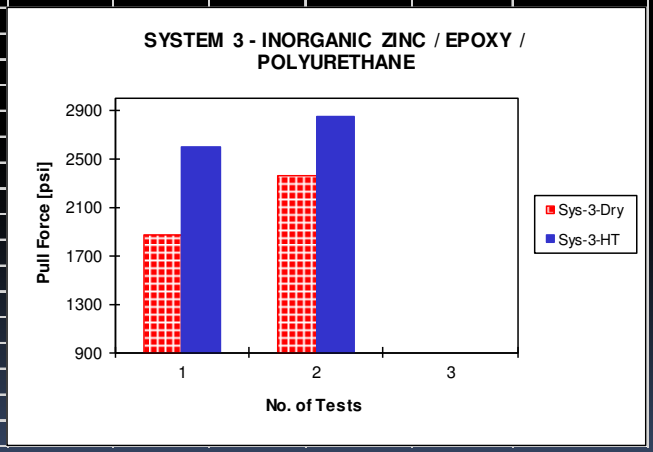
USING HOLDTIGHT TO REMOVE SALTS
PULL TEST - SHERWIN WILLIAMS COATINGS
(ATMOSPHERIC SERVICE)

Sys-1-Dry [psi]	Sys-1-HT [psi]		Sys-2-Dry [psi]	Sys-2-HT [psi]
974	1217		1217	1542
1217	1298		1866	1461

		Sys-3-Dry [psi]	Sys-3-HT [psi]	
		1866	2597	
		2353	2840	



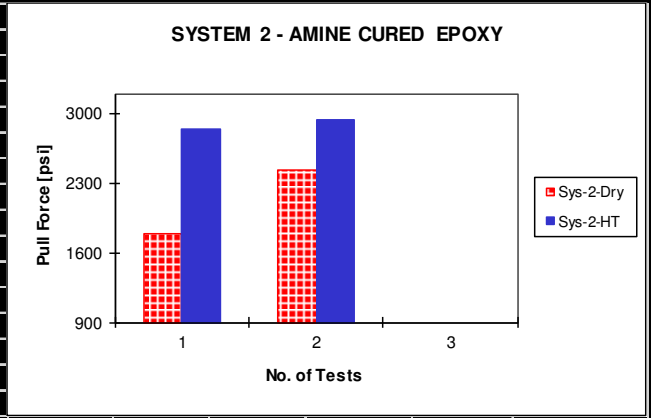


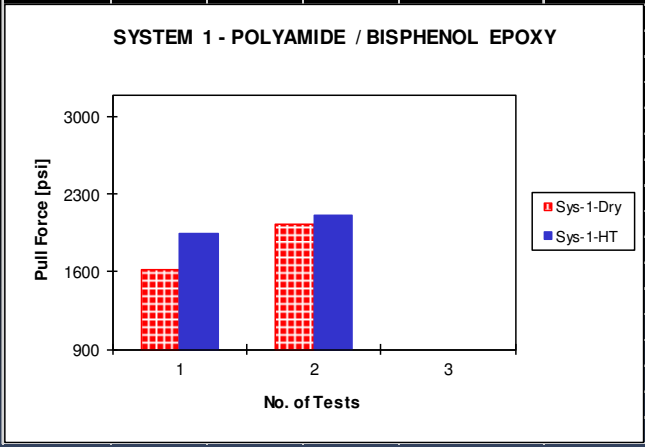


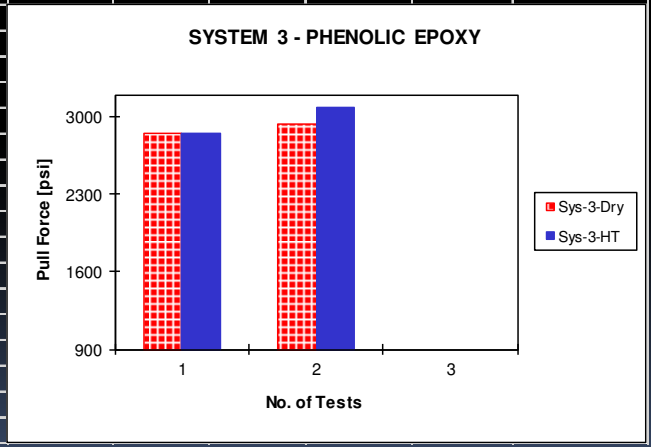
USING HOLDTIGHT TO REMOVE SALTS
PULL TEST - SHERWIN WILLIAMS COATINGS
(IMMERSION SERVICE)

Sys-1-Dry [psi]	Sys-1-HT [psi]		Sys-2-Dry [psi]	Sys-2-HT [psi]
1623	1949		1786	2845
2031	2112		2438	2927

		Sys-3-Dry [psi]	Sys-3-HT [psi]
		2845	2845
		2927	3090







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