

Barrier Series Prefinished Sheet Steel:

Product Performance & Applications



Canadian Sheet Steel Building Institute
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PREFACE

This publication is an educational tool intended to give guidance to anyone specifying paint systems for sheet steel building products. This particular publication deals with Barrier Series prefinish system intended for more aggressive environments.

The material presented in this publication has been prepared for the general information of the reader. While the material is believed to be technically correct and in accordance with recognized good practice at the time of publication, it should not be used without first securing competent advice with respect to its suitability for any specific application. Neither the Canadian Sheet Steel Building Institute nor its Members warrant or assume liability for the suitability of the material for any general or particular use.

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BARRIER SERIES PREFINISHED SHEET STEEL: PRODUCT PERFORMANCE AND APPLICATIONS

The challenge for today's cladding specifier is to choose a system capable of providing long-term performance whether the environment is localized as a result of on-site processing or nearby industry, or widespread due to geographic region. Amid the multitude of building materials available, Barrier Series stands out as the leader in durable, economic protection in a wide variety of industrial and architectural applications.

In 1969, the need was recognized for a prefinished steel product suitable for more aggressive industrial applications. Thin-film systems were not developed for the harsh, corrosive environments of many industrial applications. Other cladding materials have proven inadequate in withstanding a wide variety of harsh environments or inappropriate for the extremes of the Canadian climate. After several years of development and testing, followed by field testing, Barrier Series was introduced to the market.

Today, Barrier Series on galvanized Z275 (G90) substrate is one of the most durable steel cladding materials available, with a track record of over twenty years proven performance in hundreds of installations and a variety of demanding applications across Canada and the United States. The product has been used extensively in chemically aggressive environments often found in heavy industrial applications, consistently demonstrating its superiority in areas where the elements in combination with salts, acids, alkalis, oxidizing agents and industrial and automotive fumes are quickly deteriorating a variety of other building materials. Specifiers also are discovering its advantages under less harsh conditions for architectural applications where corrosion

concerns are greater than normal. For example, buildings near salted roadways or marine environments, residential roofs, designs that feature sheltered overhangs, and even corrosive interior environments such as indoor swimming pools and high humidity areas.

Today many installations have made Barrier Series part of their plant specification and order it routinely for new construction and as replacement cladding for other materials. They have come to rely on the consistent quality and performance of Barrier Series to meet their needs.

This publication documents field applications, provides some of the information necessary when selecting Barrier Series cladding and decking for a particular application and describes some of its key attributes. Laboratory test results are included for comparative information purposes. This data can be used for preliminary comparison of the performance of various systems, the first step in the selection process. The significance of laboratory evaluation becomes increasingly apparent as each test result is backed by proven excellence in field performance.

DESCRIPTION OF BARRIER SERIES

Barrier Series is comprised of a continuously hot dipped galvanized sheet steel substrate with a factory applied primer and polyvinyl chloride (PVC) topcoat and meets the requirements of ASTM A 755/755M. The zinc coated steel substrate conforms to ASTM A653/653M, coating designation Z275 (G90). The zinc coated steel substrate is normally available in thicknesses from 0.38 mm to 1.30 mm (0.015 in. to 0.051 in.) and in widths up to 1219 mm (48 in.). Barrier Series is available in the coating thicknesses shown in Table 1. The topside surface (normally

Table 1: Barrier Series - Coating Thicknesses

Nominal Film Thickness ⁽¹⁾ – Top (Exposed Side)		Nominal Film Thickness ⁽¹⁾ – Reverse Side ⁽⁴⁾	
µm	Mils ⁽²⁾	µm	Mils ⁽²⁾
200	8	Washcoat ⁽³⁾	Washcoat ⁽³⁾
200	8	100	4
200	8	200	8
300	12	Washcoat ⁽³⁾	Washcoat ⁽³⁾
300	12	100	4
300	12	200	8
100 ⁽⁵⁾	4 ⁽⁵⁾	Washcoat ⁽³⁾	Washcoat ⁽³⁾
100 ⁽⁵⁾	4 ⁽⁵⁾	100	4

(1) Thickness tolerance for the Barrier Series coating exclusive of zinc coated steel substrate is ±10%.
 (2) 1 mil = 0.001 in. = 0.025 mm = 25 µm
 (3) Washcoat is a thin film, approximately 5 µm (0.2 mils) thick, applied to the backside, intended only as a protection for the coated sheet while in coil form.
 (4) Barrier Series for the reverse side is typically specified the same colour as the topside.
 (5) 100 µm (4 mils) Barrier Series is intended only for residential and other applications away from heavy industrial environments.

the intended exposed surface) is textured with an embossment for uniform gloss and appearance.

Before coating with the Barrier Series system, the substrate is cleaned, and a chemical pretreatment is applied to enhance paint adhesion and corrosion protection. The Barrier Series primer is specially formulated to provide exceptional adhesion between the pretreated substrate and the PVC coating throughout the life of the cladding. The primer contains corrosion inhibitors to further improve adhesion and corrosion resistance. The primer layer is 7.5 µm (0.3 mils) under 100, 200 or 300 µm coatings. The reverse side, or Washcoat, can be applied either with the special Barrier Series primer or direct to substrate.

Unlike other plastisols, Barrier Series contains no solvent thinners, so consequently virtually none of the applied volume evaporates during curing. This approach, made possible by the unique

formulation, reduces porosity, enhances film integrity and long-term flexibility. The photochemical stability, film integrity, and long-term flexibility combine to provide lasting cracking resistance and the assurance of colourfastness for every Barrier Series colour offered.

The PVC coating is applied as a liquid plastisol and heat cured in a coil coating operation producing a homogeneous, cohesive, solid film. Barrier Series plastisol is unique in coil coating because 100 per cent of the applied wet film becomes a solid coating. This permits the lay-down of thick (100 to 300 µm) coatings with high film integrity in a single pass on a paint line. The Barrier Series thick coating offers a remarkably effective, lasting barrier against harsh industrial environments and today's increasingly aggressive urban environments.

The Barrier Series coating was specifically formulated for metal cladding. This formulation provides coating film integrity

for long-term durability as demonstrated by the following high performance attributes:

High Flexibility – A proprietary formulation provides long term coating flexibility retained after many years' exposure. Barrier Series can be factory or field formed at room temperature without special equipment. There is no cracking, chipping or loss of adhesion due to thermal stresses or from impact.

Toughness – Barrier Series is highly resistant to through-coating damage causing exposure of the zinc-coated substrate.

Weatherability – All exterior Barrier Series colours resist photochemical degradation and colour change under exposure to solar radiation. Table 2 provides typical colour change data.

Chemical Resistance - Barrier Series is chemically resistant and resists attack by alkalis, acids, salts or bleaching agents.

CASE HISTORIES

Barrier Series has been used by a wide variety of industries in every part of Canada. Field surveys of selected severe locations are undertaken regularly to verify that Barrier Series is providing the required protection and fulfilling the supplier and the customer's expectations. Presented here are case histories representing some of the oldest applications of Barrier Series in various applications. Each of the sites has shown outstanding maintenance-free service with the expectation of many years of satisfactory service ahead.

A) HEAVY INDUSTRIAL

Copper Mine and Refinery (Ontario)

The expansion of a copper mine and refinery in 1977 represents the first commercial use of Barrier Series. Several buildings on the site have been clad with Barrier Series, subjecting the product to a range of aggressively corrosive conditions. All were inspected, showing outstanding performance, some up to 19 years exposure:

- **Water Cooling Tower:** The cladding above the open tank of the water cooling tower is constantly subjected to a condensing water mist. There was no blistering or loss of adhesion at the tension bends or in the flats. The vertical mill edges were in excellent condition as were the sheared base edges and the base flashing as can be seen in Figure 1.
- **Sulphuric Acid Plant:** The acid plant was clad in Barrier Series panels and base flashing. After 15 years exposure, it was observed that while the acid had caused deterioration of the concrete foundation, the cladding was generally in excellent condition.

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Figure 1: Mine water cooling tower. West exposure above the tanks. Insert: A quick cleaning showed that the drip edge was in excellent condition. Eleven years exposure in Northern Ontario.

- **Copper Smelter:** Here, the sulphide ore is roasted and SO₂ gas can be released. After 19 years, bends and edges of the Barrier Series were in fine condition on the interior liner and on the exterior walls including 45° exposures as shown in Figure 2.
- **Refinery:** Here, the acid copper sulphate solution is electrolyzed to form 99 per cent pure copper. Above the open electrolytic cells, the air is warm, humid, and acidic. The Barrier Series interior cladding on the exhaust wall had no blisters, rusting or edge delamination. See Figure 3. After eleven years of constant wear from mine dust, sand and other airborne particulates, the low intensity embossment on the surface of the cladding had not been abraded and has largely retained its original appearance.

Pulp & Paper Mills (Ontario & Quebec)

Barrier Series has proven to be an ideal cladding selection for the corrosive, alkaline sulphate environment of the pulp and paper industry.

- **Recovery Boiler Building (Ontario):** Barrier Series was used here to enclose the recovery boiler building, 11 years old at the time of inspection. The cladding system used a 200/100 exterior and 200/100 liner. During recovery, the spent cooking liquor from the pulping process (black liquor) is first concentrated and then combusted to remove dissolved organic matter and reclaim alkali. The interior atmosphere is hot, the wall and the roof surfaces are constantly contaminated with alkaline sulphate and the air is contaminated with sulphur-bearing gases. The interior liner sheet and deck were in excellent condition. The exterior cladding is subjected to an even more aggressive situation. In addition to the alkaline sulphate, the exhausts from the other operations (including corrosive



Figure 2: Mine smelter building exterior. Base edge and 45° angled cladding exposure. Nineteen years exposure in Northern Ontario.

chlorine vapours) can be wind propelled against the cladding. The east wall directly facing the other operations, the west wall at the base of the building (see Figure 4) and the south wall at an upper elevation (see Figure 5) were all free of blisters on the panel face, tension bends and mill edges. The base edge was virtually in

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Figure 3: Mine refinery building interior. The Barrier Series cladding is above the exhaust fan. Eleven years of exposure in Northern Ontario.



Figure 4: Pulp & paper plant, recovery boiler building. Ground level west exposure below exhaust duct showing contaminate build-up and minor edge creep on the cladding. Eleven years exposure in Northern Ontario.

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Figure 5: Pulp & paper plant south wall, upper elevation of recovery boiler building. Eleven years exposure in Northern Ontario.

perfect condition on all parts of the building with the occasional exception occurring at locations affected by mill exhausts.

- **Paper Finishing Building (Quebec):** Similar performances can be seen in other paper mill applications of Barrier

Series since the initial applications in Ontario. A large Kraft and fine paper mill in Quebec used Bone White and Sky Blue in many insulated, double skin construction areas. The colour retention advantage of Barrier Series can be seen in Figure 6 showing a building with both new and nine year-old cladding.

Potash Plant (Saskatchewan)

Potash plant environments are exceptionally corrosive due to heavy chloride contamination throughout the plant. Many construction materials have a difficult time providing durable service in this industry. Barrier Series has proven to be an excellent material for this demanding end-use.

- **Raw Ore Storage Building:** This building was installed with a 300/100 exterior and 200/100 liner sheet and roof deck. After 10 years service, the exterior performance is further evidence of the premium protection afforded by Barrier Series in this extremely harsh chloride environment. The face of the panels, including tension bends, was free of corrosion. All vertical mill edges were in good condition. There was some minor (up to 15 mm) creep along the bottom edges, resulting from exposure to intermittent chloride-contaminated water puddling. The interior of the plant is hot, humid, and covered in potash, as shown in Figure 7.

B) ARCHITECTURAL, RESIDENTIAL, COMMERCIAL & AGRICULTURAL

Barrier Series is being used for cladding of non-industrial buildings where aesthetics as well as corrosion resistance are needed. Barrier Series is a cost effective and durable alternative to other building materials for homes, schools, churches and offices in corrosive environments. These corrosive environments can be the result of nearby

industry, proximity to water (particularly saltwater), protected exposures, or proximity to traffic in road-salt regions. The product can also be used for animal confinement structures in agriculture, where the animal wastes create severe corrosion conditions.

In severe environments such as those within close proximity to salt water, 200 µm Barrier Series should be used. In less severe environments, 100 µm Barrier Series will provide years of satisfactory service. The 100 µm product provides the traditional toughness and corrosion protection expected from Barrier Series at a lower applied cost.

- **Church (St. John's Newfoundland):** Marine exposures, particularly on Canada's east coast, are often classified as aggressive environments regardless of use because of the high salt contamination. The church is located approximately 2 km from St. John's harbour and was clad with Barrier Series 200/100 on sloped walls and roof. After 12 years in service, there was no deterioration evident on the flat, tension bends and side mill edges. The base edge of the cladding showed minor creep in random areas from 0 to 2 mm.
- **Residential Roof (Ontario):** Residential roofs are subject to a wide range of environmental conditions due to geographic diversity and after-installation traffic across the product. The ability of the Barrier Series product to resist physical damage sets it apart for the application shown in Figure 8. This installation is located in Ontario, on a cottage-country lake, and was clad with Barrier Series 100/washcoat. After 5 years in service, there is no evidence of any corrosion or weathering-related deterioration.



Figure 6: Kraft fine paper plant, paper finishing building. Comparison of new and old nine-year cladding. The newer cladding is on the right. Location in Northern Quebec.

APPLICATION NOTES

Colour: Barrier Series is available in a variety of exterior colours, as presented in the colour chart provided. These colours and the pigments used to produce them have been specifically chosen to be colour

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Figure 7: Potash plant, raw ore storage interior. A hot and humid potash environment containing potash dust. Note potash build-up on light fixtures. Eleven years exposure in Saskatchewan.

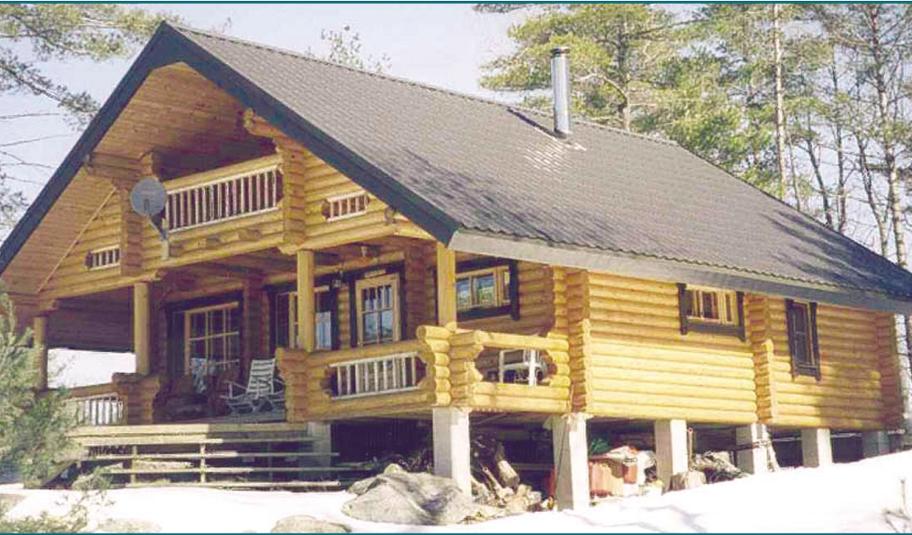


Figure 8: Ontario cottage, roof clad with Barrier 100/washcoat. Five years exposure.

Series is not recommended for composite floor deck.

Cut Edge Protection: The Z275 (G90) zinc coating provides sacrificial protection to the steel substrate by corroding preferentially, including the mill edges of a prefinished product like Barrier Series. It is possible that the exposed edges, resulting from normal fabrication processes, could in the long-term potentially result in edge creep (corrosion of the steel and potential for peeling of the paint) from the galvanic consumption of the zinc. In most applications, this reaction is slow and marginal. In those isolated instances where heavy chemical contamination (e.g. chlorides) or extended wetness is expected, the designer should consider some form of edge protection compatible with the paint system. Edges can be covered with thick film tape, waxed, hand painted or caulked with a sealant as shown in Figure 9.

Flame Spread: According to the National Building Code of Canada (NBCC), paint is considered to be a minor combustible component and is permitted in a building required to be of noncombustible construction. For the purposes of NBCC, it is understood that paint coatings can not be more than 3 mm thick to be considered as paint. The thickest Barrier Series coating is 12 mil or 300 µm thick.

Geographic Limitations: Barrier Series will exhibit a greater colour change in southern climates. For this reason, white and pastel colours should be considered for projects outside Canada in southern locations.

Forming and Fabricating Limitations: Barrier Series can be readily cold formed by cold rolling into almost any deck or panel configuration. Barrier Series can bend back on itself (i.e. a bend radius of zero times the thickness, or "0T") without film cracking.

fast and to retard ultra-violet degradation of the PVC resin. It is for this reason that the Barrier Series colour range is not as broad as the other exterior prefinished paint series, and special colour development cannot proceed without a thorough technical assessment. Note that the QC-1546 Interior White colour is specially formulated to resist sulphide staining in locations not subject to outdoor ultra-violet weathering and should only be used for interior applications.

Surface Embossment: One side (the top side) of Barrier Series is given a mild embossment to enhance uniformity of the finish. It is recommended that this be the exposed face.

Roof Decking: Barrier Series can be roll formed into a variety of profiles for roof deck, and can be used in applications where the underside of the deck is exposed to the building interior. The coil will be roll formed to place the topside coating on the underside of the deck. A washcoat is normally specified for the reverse side of the sheet. The vapour barrier needs to be mechanically fastened to the deck, since adhesives used to bond a vapour barrier to a Barrier Series coating have not been approved by all insurance agencies. Barrier

Touch-up: The thick and tough Barrier Series film is difficult to penetrate, which reduces the need for paint touch up. Should the damage be severe enough to penetrate the coating, the sheet must be replaced.

Repainting: Weathered Barrier Series makes a good substrate for repainting, to either freshen the appearance, or change the colour. Repainting new installations is more difficult. In either situation, consult your paint supplier for appropriate repainting methods.

Brittleness and Heat Stability: The brittle transition temperature and the heat stability temperature provide a good working range for the system. The PVC film embrittles at -20°C (-4°F) and should not be formed below this temperature. The film is heat stable to 100°C (212°F) for short periods. A maximum ongoing exposure temperature (service temperature) of 65°C (150°F) is recommended.

Food and Drug Approvals: Contact your CSSBI fabricator members for information on approved systems.

Storage and Handling: Barrier Series product should be stored in cool, dry conditions prior to erection. Plastic tarps should not be used. Foam interleaving or sheet protection that traps moisture between the sheets should not be used.

FIELD PERFORMANCE

The exceptional performance of Barrier Series in the broadest cross section of corrosive applications is the strongest confirmation that it is the foremost corrosion resistant cladding material. While Barrier Series has been used to striking aesthetic advantage in cladding design, the principal attribute is long-term



Figure 9: Example of effective edge sealing with caulking on an exterior wall.

performance. Appropriate accelerated laboratory tests were selected to examine the ability of Barrier Series to satisfy these two critical requirements.

Table 2 provides a summary of several laboratory tests on Barrier Series product. Unless otherwise noted, the test samples are 203 mm x 101 mm (8 in. x 4 in.), with 200/100 (8/4 mil) coating i.e. $200\ \mu\text{m}$ (8 mil) topside and $100\ \mu\text{m}$ (4 mil) reverse. Where appropriate, test panels are given a 90° , 1.6 mm (0.063 in.) inside radius brake bend at room temperature to simulate profile tension bends. The results are typical values generated from random product sampling. They are not minimum values and cannot, therefore, be considered to be a specification.

When promising test results are combined with positive field performance in well-documented and well-defined environments, a solid information base becomes available for a more insightful assessment of new applications and end uses. The field performances referenced in Table 2 are representative of several individual field inspections carried out.

Table 2: Summary of Barrier Series Laboratory and Field Results

Test and Exposure Conditions	Barrier Series Laboratory⁽¹⁾ Test Results	Barrier Series Field Performance
Condensing Humidity	3000 hours – no blistering or loss of adhesion	19 years corrosion- free service on a cooling tower
Sand Abrasion	100 L/mil of coating thickness to steel exposure	Excellent performance in erosive mining and potash environments
Formability	0-T 180° Bend – no cracking	No significant tension bend corrosion noted to date (20 + years)
Impact	No cracking or loss of adhesion up to 18 Joules ⁽²⁾	Badly dented pulp warehouse wall free of corrosion (after 8 years)
Heat Stability	-20°C to 65°C ⁽³⁾	Outstanding service in extreme climates
Colour Stability	All colours typically show ΔE less than 10 after 20 years in Southern Ontario	20+ years of excellent performance in demanding dark colours

(1) Accelerated testing. See Appendix for description of testing conditions.
 (2) For 0.61 mm (0.024") thickness. The amount is thickness dependent.
 (3) Barrier Series should not be exposed to high temperatures for extended periods. Short term exposures up to 100°C will not damage the product, but for extended service a maximum temperature of 65°C should be observed.

SUMMARY

Barrier Series has proven itself over numerous applications to be a durable cladding system for the harshest environments. Numerous laboratory tests and field evaluations of sites, some over twenty years old, verify that its performance is excellent. Its long-term durability makes it the unquestioned choice for cladding and roofing applications in aggressive environments.

Need More Information? Should a question arise regarding the suitability of Barrier Series for a particular application, please contact your CSSBI fabricator for additional guidance.

APPENDIX

Typical laboratory tests conducted on Barrier Series and their results are described below:

CONDENSING HUMIDITY:

Specification ASTM D 2247

The test is a measure of performance in environments and exposures experiencing a long time of wetness in a neutral environment. Panels are exposed to condensing humidity (100%) at 38°C (100°F). **Result:** Barrier Series has been tested in this exposure to 3000 hours with no blistering or loss of adhesion.

FALLING SAND ABRASION:

Specification ASTM D 968

This test examines the coating's resistance to erosive actions such as blowing dust, sand, sleet, snow, etc. Sand is dropped from a height of four feet through a funnel onto an angled, flat sample. **Result:** The coating withstood 100 litres of sand per mil of coating thickness before exposing the substrate.

FORMABILITY:

Specification ASTM D 522

The test examines barrier coating continuity and physical adhesion after a severe deformation. The panel is preformed around a mandrel and then compressed to the desired bend diameter in a vise. **Result:** Barrier Series can accept a 0T, 180° bend without cracking or loss of adhesion.

DIRECT AND REVERSE IMPACT:

Specification ASTM D 2794

This test determines the organic coating's ability to withstand non-cutting forces provided that metal fracture does not occur. At room temperature, a standard weighted ball is dropped from a height so as to deform the substrate and the coating. The coating is then checked for damage or adhesion loss due to the effects of rapid

deformation (impact). **Result:** Barrier Series had no cracking or loss of adhesion at impacts to at least 18 Joules.

COLOUR STABILITY:

Specification ASTM D 2244

An exterior cladding should not exhibit excessive colour fade when exposed to sunlight. For the purpose of measurement, colour can be defined as the location of a point on a three-dimensional coordinate system where one axis represents the blue-yellow line, another the red-green line and the last the white-black line. Fade (or any colour change) is the difference in position of the two points defining the colours in much the same way as the length of a line defines the distance between two points. The colour change is measured in units of ΔE ,

where, $\sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}$

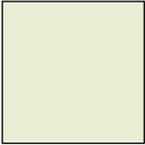
Result: All Barrier Series colours when exposed 45° south on test racks in Southern Ontario had ΔE less than 10 after 20 years.

Barrier Series Prefinished Sheet Steel

COLOURS AVAILABLE FOR BARRIER SERIES



QC1501
White



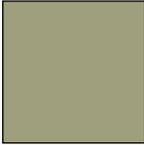
QC1508
Bone White



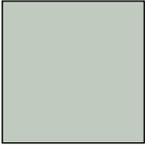
QC1575
Alouette White



QC1546
Interior White
(Interior use only)



QC1513
Light Grey



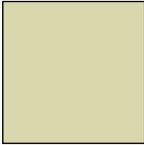
QC1562
Dove Grey



QC1584
Grey



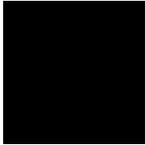
QC1593
Pewter



QC1570
Greystoke



QC1504
Charcoal



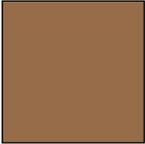
QC1517
Black



QC1558
Tile Red



QC1524
Canners Brown



QC1512
Medium Brown



QC1585
Brown



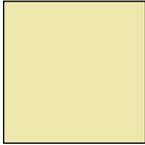
QC1518
Dark Brown



QC1592
Herringbone



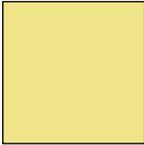
QC1583
Wickertone



QC1539
Antique Ivory



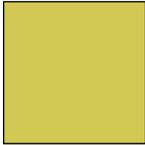
QC1581
Beige



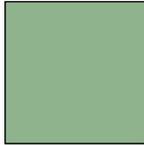
QC1565
Mocassin



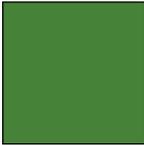
QC5875
Light Gold



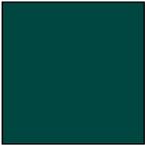
QC1511
Gold



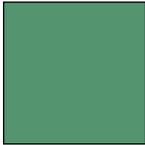
QC1520
Sea Green



QC1521
Gulf Green



QC1594
Green



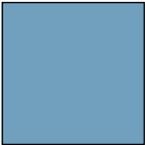
QC1509
Pacific Turquoise



QC1573
Alouette Teal



QC1556
Sapphire Blue



QC1555
Sky Blue



QC1576
Alouette Blue



QC1516
Monterey Blue

Note: Printed colours may vary from actual paint samples.