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THE POWER HALL, MUSEUM OF SCIENCE AND INDUSTRY, MANCHESTER
ARCHITECTURAL HISTORIC PAINT RESEARCH AND ANALYSIS REPORT
SPECIFIED EXTERIOR AND INTERIORS AREAS AND ELEMENTS

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12th AUGUST 2020

Celebrating 37 years in Conservation



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BRIEF:

This research project was undertaken in Spring/Summer 2020 by Ian and Michael Crick-Smith.

As part of a larger project of refurbishment and re-presentation of the Power Hall, the Museum of Science and Industry were keen to understand the history of paint schemes and finish that survived within the Power Hall and on the external Crane/Gantry structure associated with it.

Crick Smith Ltd were appointed to undertake an architectural historic paint research exercise to provide the information, which would then inform the decision making processes for redecoration as part of representation.

A main sampling site visit was made in February 2020 to undertake localised site investigations and remove samples for cross-sectional analysis.

This report records the evidence for the original finishes, details of the earliest decorative history, notes those schemes that relate to significance dates of alteration and repair and also those that can be related to archival evidence and/or images.

The following section of this report is included to guide the reader in understanding both the process and the findings of the research. For many the discipline of architectural paint research or paint analysis in its developed form is a new discipline and a significant advancement on the traditional method known as 'paint scrapes'.

ARCHITECTURAL PAINT RESEARCH:

METHOD:

To fully examine the decorative schemes a combination of paint scrapes/uncovering and paint samples were employed. Uncovering helps to analyse the surface of each scheme, whilst paint samples mounted in cross section enable us to examine the decorative history of the room in the vertical plain.

The technique of paint uncovering involves scraping back layers of paint using a scalpel to reveal the decorative scheme below. This allows investigation of surface patterns that may be missed when analysing a paint sample and by physically revealing the historic surface allows colours to be accurately quantified.

Paint sampling involves removing a sample from the wall to include the paint and substrate.

The samples, including substrate, are mounted in polyester resin in cross-section and polished back to reveal the full stratigraphy of the paint layers applied to the building's interior throughout its history. The earliest



paint layers appear at the bottom of the sample, with subsequent layers stacked above, as they would have been applied in real time.

The sample is then viewed through a microscope at various magnifications under simulated daylight to determine the distinct layers of paint applied and to reveal colours. The presence of dirt layers helps to determine the separate decorative schemes – a scheme can be made up of more than one layer, commonly a primer and topcoat or historically even three or four layers.

Ultra-violet illumination causes different types of paint and varnishes to fluoresce in a characteristic manner, helping to distinguish traditional oil paints (both lead and zinc based) from modern synthetic alkyds, distempers and varnish coatings.

TERMINOLOGY:

Paint samples

A physical sample removed from a surface, ideally to include all paint layers and substrate. Similar in process to a medical biopsy. Though collected on site, investigation of paint samples commonly occurs off site in our laboratory. Samples are mounted in blocks of resin, and viewed in cross-section under the microscope to determine the build-up of paint layers. However, as

only a small section is analysed, it can often miss patterning or polychrome schemes if examined in isolation.

Numbering & Naming Convention

A number of samples are mounted within a resin block (typically, about eight to ten). The blocks are numbered in sequence, starting at 1, with the individual samples as a sub-section of the block. For example, a sample numbered “2.7” corresponds to block number 2, sample 7. This convention is reflected consistently throughout the report and summarised in the **Sample Location List** (along with a descriptor), for example as
2.7: Chancel Column Capital waterleaf moulding

Paint scrapes/uncovering

The in-situ removal of layers of paint from a surface. This is achieved through either mechanical (e.g. scalpel) or chemical means. It is used to reveal patterns and polychrome schemes that may be missed by single-point paint sampling. A particular layer may be also targeted in order to obtain a colour reference. Although build-up of layers can be identified using this method, the difficulty of distinguishing between layers without high magnification means that the use of paint scrapes in isolation risks inaccurate and incomplete results. *Also known as: matrix uncovering, laddering, cratering.*





Cross-section

A removed sample made by cuts through the painted surfaces perpendicular to the lay of the paint layers. This enables us to view the build-up of layers.

Photomicrograph

A photo taken through the microscope recording the viewed image.

Paint Layer

A single application of paint

(Decorative) Scheme

The applications of paint, wallpaper, gilding or varnish with the aim of refreshing or redecorating a surface or area. A decorative scheme may be formed from a single layer of paint etc. or from a set of layers. For instance, four layers: a primer, basecoat, topcoat and varnish, may be constitute a single decorative scheme.

Substrate

The underlying material that the paint (or wallpaper etc.) is applied to, for instance the plaster on a wall, or the wood of a skirting board. It is important to obtain a paint sample complete with the substrate in order to determine if the earliest layer of paint is the

earliest decorative scheme. Damage to the substrate, or traces of another paint would indicate that the surface was stripped and so the earliest evidential paint layer is not the first that was applied. Similarly, dirt on the surface of the substrate may indicate that it was original left unpainted.

Primer

A substance used as a preparatory coat on wood, metal, or canvas, especially to prevent the absorption of subsequent layers of paint or the development of corrosion.

Sealing coat / builders or foundry finish

A size, distemper paint or other substance applied to a surface – lime, timber or metal as preparation for the first decorative scheme of paint. A builder's finish was often applied whilst the slow drying lime plaster cured – a process that could take up to a





year. However, this was often deemed to be part of the plasterer's work and not necessarily as a decorative scheme.¹

Top-coat

The final paint layer applied in the desired final colour or finish.

Varnish

Resin dissolved in a liquid for applying on wood, metal, or other materials to form a hard, clear, shiny surface when dry.

Commonly used to protect a surface and improve its longevity, and provide a washable surface. The appearance of a varnish layer may indicate a special, complex or expensive decorative scheme, e.g. polychrome design, gilding, wood-graining etc.

Dirt Layer

After decoration and throughout the lifetime of a decorative scheme, dirt, dust, debris and other particulates become deposited on the surface of the paint. When a new decorative scheme is applied, this build-up of deposits becomes sandwiched

between the old and new layers and is visible under the microscope. Taking into account environmental factors, the size of the dirt layer corresponds to the length of time the paint layer it sits on was exposed to the air for.

Thus, the heavier the dirt layer, the longer amount of time between decorative schemes. The lack of a layer of dirt deposits between two paint layers indicates that those paints were applied as part of the same decorative scheme e.g. the application of a basecoat and a topcoat.

Paint

Paint is commonly made from four components: pigment for colour, binder to hold everything together, dryer to enable the drying or curing of the binder and an extender to bulk out the paint and require less pigment.

Oil paint

Paint made with a drying oil binder, e.g. linseed oil.

Alkyd paint uses a synthetic alkyd resin as a binder. Although available for retail in the UK in 1929, disruption to production due to WWII and a distrust of new paint technologies meant that alkyd

¹ Davis, J (2006) Microscopy and archival research: interpreting results within the context of historical records and traditional practice. *Infocus: The Proceedings of the Royal Microscopical Society*, 3. 38.





paint for decorative purposes was not in common use until at least 1949.²

Zinc paint uses zinc compounds to aid drying of the oil. Zinc paints for interior use were originally developed in the 1840's by a Frenchman, E. J. Leclaire, obtaining an American Patent in 1850, though patents for lead paint were to granted in 1846 and 1849. The use of zinc in paint was revered for its ability to resist discolouration when exposed to sulphur gasses, a problem that occurred in lead-based oil paints, particularly lead white. Commercial production was underway by the second half of the 19th century.³

Titanium dioxide paint uses titanium dioxide to give a more brilliant, stable and opaque white when compared to lead or zinc.

Although discovered in 1821, it was popularised and became the basis most white house paints from 1921 onwards.

Lead paint uses lead compounds to aid the drying of the oil.

Lead in linseed oil was the predominate paint base until a rapid decline the 20th century due to increasing concern over its toxicity. White lead in paints fell during 1900-45 from nearly 100% to less than 10%.⁴

Distemper paint

Soft distemper is a permeable paint where the binder is an animal glue. Commonly used with large quantities of whiting (chalk dust) as an extender, optionally with pigments added to provide colour. Distempers are water soluble and usually, but not always, washed off before the application of a new scheme.

Oil bound distemper popularised in the 19th century, a distemper paint with the addition of oil with an emulsifier such as borax (sodium borate). Unlike soft distempers it is more durable and often washable.

² Standeven, H. (2007) Cover the earth: a history of the manufacture of household gloss paints in Britain and the United states from the 1920's to the 1950's. pp.75-84. In: Learner, T. (2007) Modern Paints Uncovered: Proceedings from the Modern Paints Uncovered Symposium. Los Angeles: Getty Publications.

³ Channing Downs, Jr., A. (1976) Zinc for paint and Architectural use in the 19th century. *Bulletin of the Association for Preservation Technology*. 8 (4). 80-99.

⁴ World Health Organisation IARC (1989) Some Organic Solvents, Resin Monomers and Related Compounds, Pigments and Occupational Exposures in Paint Manufacture and Painting. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 47.



HISTORY:

1856

The shipping shed was built in 1856 by the London and North Western Railway as a railway goods transshipment shed for Liverpool Road Station, which had been operating as a goods station since 1844. The purpose of the building was to quickly move goods from train wagons onto horse-drawn carts for distribution around the city. For nearly 150 years, Liverpool Road Station was bursting with produce from all over the world, providing Manchester's manufacturers access to a global market.

Figure 1: 1934. Tobacco boxes being transferred from rail to road vehicles at Manchester Liverpool Road station goods depot.



Figure 2: 1975 Liverpool Road Station was closed by British Rail in 1975.



Figure 3: 1978 Power Hall in 1978. Liverpool Road Station Society



Heritage enthusiasts recognised the historic importance of the site, and the Liverpool Road Station Society was formed. They aimed to secure the safety of the buildings and ultimately restore them.

Figure 4: 1980 Replicas of Rocket and other locomotives are brought together at the Great Railway Exposition, 1980. Liverpool Road Station Society.



Figure 5: Power Hall progress shots from 1982-1983.



Over the next three years, the derelict shipping shed was transformed into the Power Hall of the North Western Museum of Science and Industry.

In 1983, the Power Hall opened to the public, and became the first of the galleries in the museum.

Figure 6: The Crane Gantry, 1982.



Figure 7: The Crane Gantry in its present form



(all historical text and images taken from the MoSI own website)



RESEARCH FINDINGS:

The chart on the following page records the evidence identified on all samples investigated during this research exercise of the Power Hall and associated Crane Gantry.

There is clear evidence for some the original and subsequent decorative schemes and also of replacement elements and removal of earlier finishes in localised areas. The original brief included the sampling of the more recent window frames. However, these were identified as manufacturer powder coated finishes and therefore were not sampled as part of the investigation programme. The results are recorded on the following pages.

Following on from the chart are a series of images of the most significant paint cross-sections, each of which is annotated with the scheme details. The cross-section included are for reference only and are representative for each interior.

The colours within these cross-section serves only as a general indication of the original finish colour and should not be seen as a close rendition of the original colour. For the purpose of redecoration colour references will be provided, once the project team have decided on which scheme to reinstate. Where colour references are provided these are taken from the Natural Colour Scheme* or NCS range. This is a recognised industry standard for colour notation and can be matched by all major and most other paint manufacturers.

(*NCS-Natural Colour System property of and used on licence from NCS Colour AB, Stockholm 2015. References to NCS in this publication are used with permission from the NCS Colour AB. The colours might not exactly match original NCS colour samples. Please refer to www.ncscolour.co.uk for accurate samples.)



Scheme chart recording the paint schemes and history, surviving at the Power Hall and on the Crane Gantry at the MoSI, Manchester

Element Scheme details	Rainwater goods generally	Large cast iron columns	Cast iron column 'capitals'	Iron straps and plates to beams (various)	Main roof timbers, beams etc (limewash traces)	Crane Gantry, representative of all areas sampled
11: extant 2020	Black oil paint over a grey undercoat	Black oil paint over a grey undercoat	Black oil paint over a grey undercoat	Black oil paint over a grey undercoat	Traces of later stone colour limewashes, which are now heavily fragmented and lost from the majority of areas	Dark grey oil paint over a mid grey undercoat
10: Major refurb. RWG replaced, columns restored? 1980s?	Red lead oil paints	Red lead pigmented oil varnish	Mid cream lead oil paint	Disrupted schemes of various stone colour lead oil paints with varnish coats. Varnish was often applied to extend the life of the paint, particularly in harsh environmental conditions, such as seen here in train sheds		Dark grey lead oil paint
9:	Evidence for surface rust but no traces of earlier finishes,	Extensive surface rust and pitting	Mid cream lead oil paint			Mid grey lead oil paint
8:			Pale pinky/cream lead oil paint with heavy surface dirt			Mid grey lead oil paint
7:	RWG possibly replaced?	Evidence suggesting that any original paint has been lost and the surface oxidised, forming its own protective surface	Warm pink/cream lead oil paint			There is a large phase of red/brown lead oil paints applied directly to the iron surfaces.
6:			Warm pink/cream lead oil paint			
5:	Warm pink/cream lead oil paint					
4:	Warm pink/cream lead oil paint					
3:	Pale cream stone colour lead oil paint		3 schemes of pale cream and very dirty limewashes. Applied directly to the timber indicating an original finish.			
2:	Mid stone colour lead oil paint					
1: Earliest evidence for paint schemes	Mid stone colour lead oil paint x 2					
Substrate	Cast iron	Cast iron, heavily oxidised (rust)	Cast iron, no rust	Cast iron, some rust	Softwood but no surface dirt beneath paints	Iron possibly both cast and forged Date not known.

The research, as recorded in the preceding chart clearly identifies the rain water goods as modern replacements. It also records that the main iron columns were not frequently maintained at the earlier period, as surface pitting and general oxidation has occurred. It is only at scheme 10, that the columns have been cleaned down and painted. Figures 1 to 3, earlier in this report, clearly record how the surface of the columns slowly discoloured and deteriorated over time. It is in figure 4, from the 1980s that they appear to have been repainted. In contrast, the cast iron column capitals, which relate to the plates and strapwork fitted to reinforce and support the roof timbers, have been frequently repainted over the years. The first 8 schemes being in variations of stone colour, cream in scheme 9, and then black from scheme 10 until the last decoration, attributed as museum period.

Interestingly, the roof timbers also show evidence for redecoration at the earliest period, and perhaps at later dates, although the evidence appears to have flaked away. These timbers were painted in pale (natural) stone coloured limewashes, in contrast to the stone coloured lead paints of the iron capitals and structural supports. The use of the two paint types for these differing substrates, iron and timber, indicates a knowledge and understanding of material behaviours. The limewash would afford some protection to the timber, while accommodating seasonal and environmental influences that cause movement to the substrate, while allowing for permeability, and not trapping in moisture from either condensation or roof leaks. The iron elements however, need the protection provided by an impermeable lead oil paint to prevent the rusting of the substrate, yet still retaining flexibility around joints and welds where the metal expands and contracts.

Both limewash and oil paints were of stone colours.

The later museum schemes, of black oil paints, have no historic precedent in the earlier decorative history of the Power Hall.

Similarly, the history of paint types and colours applied to the Crane/Gantry is also interesting. The whole structure has always been painted in a single colour as one would expect. The early and most significant phase of schemes, again continues up to scheme 8. Unlike the more recent grey oil paints, the earlier decorations were in very similar, but slightly differing red/brown lead oil paints. These colours being commonly used on industrial sites. The current grey appearing in later schemes but having no historic precedent for the original and earlier period of the structure.

Figure 8: Representative rain water goods, section of internal downpipe (now identified as late C20th replacements)



Figure 9: Sample no. MoSI/PH/ 1.1

Interior rain water goods, including high level elements



DESCRIPTION OF LAYERS:

Current scheme of black oil paint over a fine grey oil paint undercoat. C20th in material and appearance

Two thick coats of red lead based red coloured oil paint. These again are typically earlier C20th.

A very thick putty repair to the section joint on the drainpipe. Most samples from the rain water goods readily fragmented due to the thin and few number of paint layers. The putty of the joint has held this sample together.

All of the rainwater good sampled, at floor level and at high level, revealed the same evidence. The lack of earlier schemes on all of the items sampled suggests either extensive refurbishment of all of the rain water goods, or full replacement during the early twentieth century.

Figure 10: Large iron columns supporting the roof structure

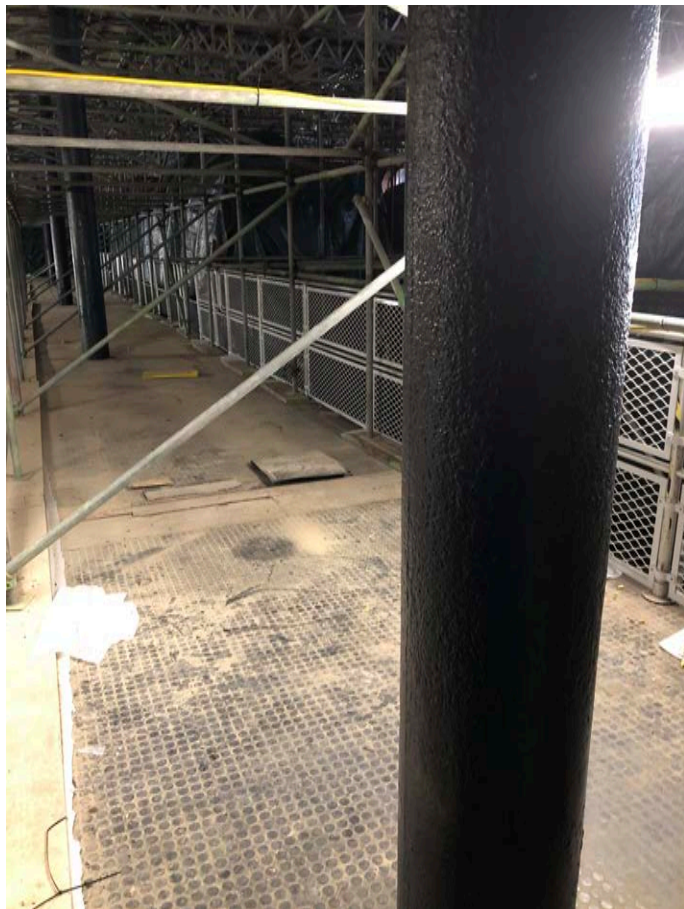
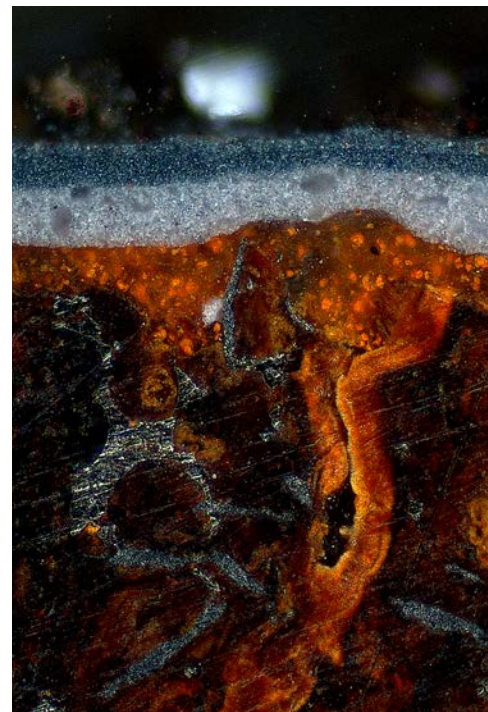


Figure 11: Sample no. MoSI/PH/ 1.2

Large columns supporting roof structure



DESCRIPTION OF LAYERS:

Current scheme of black oil paint over a fine grey oil paint undercoat. C20th in material and appearance. As seen on the rainwater goods.

A very thick coat of varnish to which pure red lead pigment has been added. This treatment is typically undertaken on corroded and weathered iron surfaces. This again indicates extensive stripping back and refinishing in the C20th

The surface of the iron, beneath the applied coats, is very corroded and eroded, with deep fissures down into the iron surface.

There are no traces of earlier schemes.

Figure 12: Large iron column capital



Figure 13: Sample no. MoSI/PH/ 1.4

Large iron column capital



DESCRIPTION OF LAYERS:

Final scheme of pale grey oil undercoat with a dark grey/black top coat

Two schemes of mid cream stone coloured lead oil paint

Deposits of dirt and oily matter

a single scheme of paler pinky-cream lead oil paint

A phase of warm pinky-cream stone coloured lead oil paints, very similar to the earliest schemes

A single scheme of pale creamy stone coloured lead oil paint. Paler than the earlier phase.

The earliest phase of schemes consists of 3 mid stone coloured lead oil paints. these each have oil dirt deposit on the surfaces.

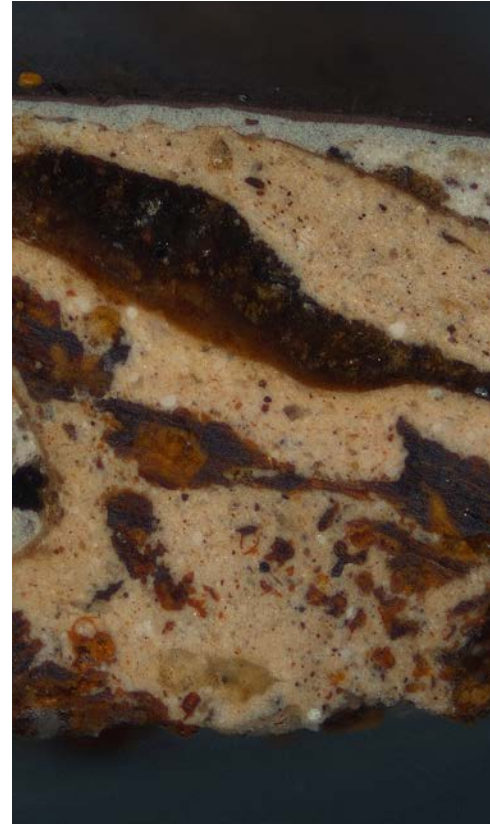
Substrate iron, which is very rusty and surface degraded. The first paint layer over this has seeped into the open surface.

Figure 14:



Figure 15: Sample no. MoSI/PH/ 1.6

Vertical iron beam strap



DESCRIPTION OF LAYERS:

current scheme of dark grey/black oilpaint over a pale grey undercoat

the earlier schemes are in stone coloured lead oil paints, some of which have a protective layer of a varnish over the surface.

These earlier schemes are now heavily disrupted and mixed up due to stripping prior to the current scheme.

On the following page a sample of limewash from the beams are recorded. It is suggested that the beams were painted with limewash, while these iron components, which would have rusted very quickly under lime wash, were instead painted in a similar coloured lead oil paint.

Traces of iron mill scale from the strap surface

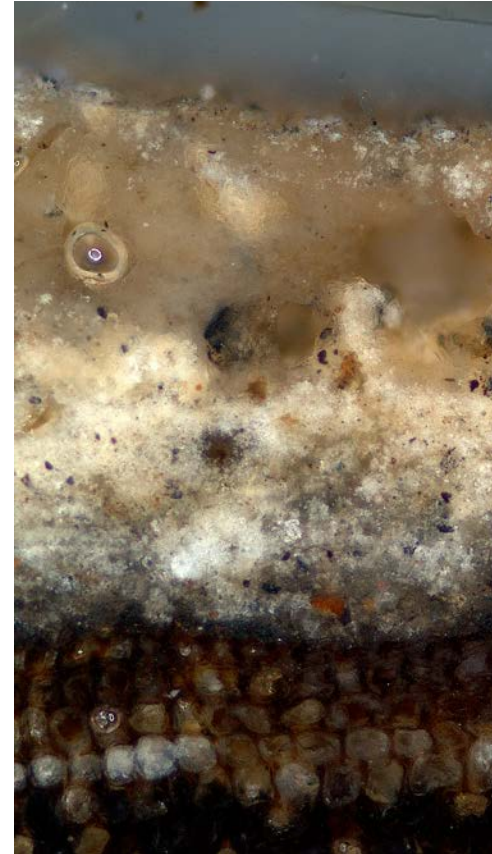
Figure 16:



Figure 17: Sample no. MoSI/PH/ 2.8

Traces of earlier limewash on the surface of the beams

DESCRIPTION OF LAYERS:



The sampling of the coatings on the beams has proved that these timbers were originally painted with limewash.

Two coats were identified, although originally there may have been more.

This limewash treatment is seen in figures 1 to 3, which record the beams in this much paler finish

Substrate softwood

Figure 18:



All of the Crane Gantry samples showed the same surviving history or traces of, that tie in with the representative sample shown here.

Figure 19: Sample no. MoSI/PH/ 2.9



DESCRIPTION OF LAYERS:

Modern grey lead undercoat with a dark grey top coat

A thin red lead primer, with a thick coat of aluminium in a dark varnish base as an additional primer.

There is then a dark grey lead oil paint top coat

This scheme repeats the previous decoration.

A move away from the earliest phase is this scheme of red lead primer with a mid grey undercoat and finish coat.
The surface of the scheme has extensive sooty deposits.

The earliest and highly significant paint schemes identified on the crane gantry all consist of this phase of at least 4 decorations. Each is virtually identical, in dark red/brown ochre and iron oxide pigmented lead oil paints.

Substrate iron, some mill scale



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