WESTINGHOUSE

WANL-TMI-549

From: Astronuclear Laboratory
Date: March 1, 1963
Subject: COLOR CODING
ORIFICES
References: EM 41:41:05-4W

WESTINGHOUSE ASTRONUCLEAR LABORATORY

Mr. P. A. Nelson
Mechanical Design

cc: W. H. Esselman
W. G. Roman
J. Kenney, Jr.
A. Selz
M. J. Manjoine
B. C. Wells
W. H. Arnold
C. K. Kim
Library (2)
File (5)

MASTER

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

In response to the above Work Request, an investigation was made to determine if it is feasible to color code the jet orifices with some commercial paint or dye for identification during assembly of the NRX A-1 reactor.

Color photographs available upon request.

L. E. Parsons,
Engineering Mechanics

Approved:

M. J. Manjoine, Manager
Engineering Mechanics

leg

DISTRIBUTION OF THIS DOCUMENT UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

ABSTRACT

An investigation was made to find a method of color coding the various jet orifices with different hole sizes to facilitate assembly of the NRX A-1 core. High temperature paints, ceramic paints, temperature indicating paints, and cements were investigated. Various degrees of success were obtained. No one type of paint was found which had excellent adherency after application and after being subjected to 1500°F for one-half hour, yet was available in many colors, was easy to apply and use, and had a very thin coat after drying. Some colors of high temperature paints will do as an alternate method to that of colored plastic caps presently planned.

TEST RESULTS

Since there are various sized jet orifices it is desirable to have a means of visual identification related to the orifice hole size. Color coding is one means of such visual differentiation. A program was undertaken to test various paints with the following requirements:

1. Paint must adhere at room temperature (after drying) and resist peeling, chipping, flaking, etc.
2. This paint or dye must be available in at least four different colors.
3. The paint must be able to withstand temperatures of 1500°F without flaking or peeling which could possibly clog the orifice hole.
4. The paint must be able to withstand thermal shock and subsequent reheats if necessary (change of color permitted).
5. The paint must have a thin layer and be able to be used in machined identification grooves.

Many types of paints were tested with generally negative results. Sections of 3/16 or 1/4 inch 304 stainless steel tubing 1/4 or 1/2 inch long were used instead of prototype orifices. Specimens were usually brush painted, air dried, and then baked in an oven for one-half hour at 1500°F. Positive results were then generally cycled (heated, cooled, heated, etc.) many times.

After preliminary testing of various types of paints, colors, mixtures, etc., a final test was conducted on some of the more promising specimens. Color photographs of these specimens are available. Heating of unpainted stainless steel to 1500°F will cause an oxidation and a discoloration of the steel. Various ordinary enamels, spray paints, and general purpose paints were tested. They usually blistered, peeled, or burned off long before a temperature of 1500°F was realized. There is no commercially available paint or dye known to the author which is guaranteed to satisfy the requirements previously listed. There are some paints available which will nearly fulfill the requirements.

Various high temperature indicating paints were tested first. Tempilaq (temperature indicating lacquer) paint alone proved unsatisfactory due to the fact the paint dried to a powdery film at room temperature and would not adhere to the stainless steel when handled. The addition of a clear paint as a binder increased the room temperature adhesive but it could not withstand the 1500°F heat treatment. High temperature cements such as Sauereisen No. 1 and No. 16 was tried as a binder for the Tempilaq but it was not possible to obtain a thin coat. The Sauereisen cements are thick and gritty by nature and do not readily thin or mix with other paints or thinners. Since Tempilaq is a temperature indicating paint (i.e., liquefies at a prescribed temperature), color changes upon heat treating do occur. Oxidation of the steel had its effect on color changes also. The use of the Sauereisen No. 31 filler binder with Tempilaq paint produced good adhesion at room temperature and after heating to 1500°F, again a thick coating is obtained however.

There are various "high temperature paints" on the market where up to 1000°F is classified as high temperature. Samples of such paint were furnished by Midland Industrial Finish Company of Waukegan, Illinois, and by the Pittsburgh Plate Glass Company of Pittsburgh, Pennsylvania. Five colors of Midland Sicon paint were tested. All paints adhered satisfactorily after air drying. After heating to 1500°F for one-half hour, the black, aluminum, and green colors blistered somewhat but the red and brown still adhered very well. These paints were then thinned with Midland S-34 Reducer in many different ratios. The object was to obtain a thinner coat and see what effect thinning had on the paint when the heat treatment was applied. The brown and green colors could be mixed up to two parts thinner to one part paint, beyond that color identity was lost and the paint scaled after baking. The red left a charcoal finish after baking when it was thinned in a ratio greater than 1 : 1. When black and aluminum were thinned, the paint rapidly thinned and lost its color. The film was so light it could be wiped off.

Samples of Pittsburgh Plate "heat resistant" paint No. S-14216 (blue) and No. S-14216 (red) were tested. Both exhibited good adherence after drying but only the red had good adherence after baking. The blue could be scraped off at full strength or when thinned. The red underwent a color change but identification after firing is inconsequential.

Tests were conducted to determine if various colors of the same company or of different companies could be mixed to obtain a different color which could also meet the requirements. Midland's Sicon Brown, Sicon Green, and S-34 Reducer were mixed in various ratios. Resultant colors were various shades of green, olive drab, and tan. All such mixtures held up as well as the two parent paints did. Various colors of Midland and Pittsburgh Plate Paints were mixed also. Midland's green, brown and S-34 Reducer were mixed with Pittsburgh Plate's red paint. Various different combinations and mixture ratios were tried. Colors different of that of the parent paints were obtained. These mixtures withstood the baking satisfactorily also (see photographs).

Samples with Tempilaq mixed with Midland or Pittsburgh Plate paints were tested also. No suitable combination was found.

A second group of specimens of the Midland and Pittsburgh Plate Paints and/or mixtures which looked promising were tested to verify initial results. Colored photographs of these specimens were obtained.

Particular types of Sauereisen cements and paints are made for temperatures of 1500°F or higher. A few different colored cements were tried. They generally adhered to the stainless steel satisfactorily after application and after the heat treatment. However, the coatings were generally too thick and gritty. The number of available colors is limited.

For all paints tested, thickness of coating and surface condition of the stainless steel had a noticeable effect on results. All specimens were cleaned with acetone or reducer before testing to remove dirt and film. Painted specimens with pitted or rough surfaces would not generally withstand the heat treatment. When a coat of paint was made excessively thick, it would tend to peel easier after drying and would blister or peel when baked. When paints were considered to pass the heat treatment they still adhered to the specimen and would withstand normal handling. However, some paints could be scraped from certain specimens if so desired. Some, however, were difficult to scrape at all.

CONCLUSIONS

A summary of various types of paints is given below:

1. High Temperature Paints -

Various so called high temperature paints are available. Paint manufacturers usually considered 1000°F as the upper limit for these paints. Two such manufacturers paints were tested with some colors not passing and some colors passing the 1500°F baking. No such enamels were found which were specifically made for temperatures of 1500°F or higher.

2. Temperature Indicating Paints -

There are various paints designed to liquefy or change color at a prescribed temperature. Various colors (i.e., temperature ratings) of Tempilaq made for temperatures greater than 1500°F were tested. These types of paints had poor adherency at room temperatures. Subsequent to testing, Tempil Corporation also has recently come out with Pyromark, a refractory paint which can survive temperatures of 2500°F. This was not tested however.

3. Ceramic Paints -

While ceramic paints fulfill requirements (2), (3) and (4), it is generally powdery after application and requires a firing or baking period in order to obtain adherence at room temperature. This paint is generally a thick layer type of paint also.

4. Cements -

Under this category of cements or adhesive paints are mineral based (not organic) paints. Various Saue reisen cements were tried and found to withstand the heat treatment although fine thin coats were not obtained. It generally had a gritty or sandy appearance also.

5. Dyes -

Organic dyes will not withstand the 1500°F requirement. There are recent developments in high temperature dyes which may fulfill the requirements.

Orion products claims to have a process which will color stainless steel without using organic compounds. Steel manufacturers' coding dyes are not designed for the temperatures of 1500°F or greater.

Due to the difficulty in readily obtaining a paint or dye which completely satisfies all five requirements it is recommended that color coding the orifices with a paint or dye be used as a back-up for the present colored plastic cap method.