BRADY
WHEN PERFORMANCE MATTERS MOST™

EQUIPMENT VISUALS FOR PROCESS OPERATIONS

USING VISUALS TO IMPROVE EQUIPMENT OPERABILITY, MAINTAINABILITY & RELIABILITY

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Introduction

The Petro-Chemical (Chemical, Oil, & Gas) industry depends on massive amounts of sophisticated equipment, equipment systems, and processes to produce a wide variety of chemicals and petroleum products. In order to do this, the industry depends on reliable equipment to produce high-quality products in a safe and an environmentally sound manner.

Some of the challenges facing our industry include an aging workforce, skill shortages, stringent regulatory requirements, and the need for continually improving efficiencies in everything we do. Additionally, many plants and facilities are exposed to harsh environments and weather extremes in remote areas on-shore and off-shore. Establishing cost-effective ways to improve equipment and process reliability can be an ongoing challenge.

Making equipment and processes more reliable, easier to operate, and easier to maintain are very worthwhile goals. There are many proven methods for improving performance and reliability. However some of the most overlooked and lowest cost improvement tools are known as “equipment visuals.”

“Equipment visuals” include a wide variety of equipment-specific and task-specific visual cues that help improve the efficiency and effectiveness of the human interaction with equipment. These visual cues often serve as reminders or warnings:

- Communicate process settings or procedures.
- Help expose hidden parts making equipment easier to inspect.
- Significantly reduce equipment-specific training time by getting the important information ON the equipment where it is needed.
- Reduce problem-solving time with the use of equipment visuals.

Changing Work Environment

Petro-chemical facilities are struggling to come to grips with a fast-changing business climate. In the refining industry, new sources of oil extracted from sand and shale deposits require process changes to address the different physical and chemical properties of the new slates. Moreover, demand for petro-chemicals continues to grow and diversify, forcing plants to maximise throughput while implementing more sophisticated systems to create the new products demanded by industry.

New technology is also being adopted to address more stringent safety and environmental requirements. OSHA just completed an intensive inspection program of refineries focusing on process safety and reliability, and they have initiated a similar inspection programme for the chemical industry. This heightened regulatory focus, coupled with the oil and gas industry’s own desire to minimise unplanned shutdowns, accidents and injuries, is driving a renewed focus on process reliability and mechanical integrity.

In response to these trends, petro-chemical facilities are aggressively introducing new technologies and automation in order to accommodate the need for greater flexibility and reliability, as well as to minimise costs to remain competitive in global markets. Thus even experienced operators find themselves working in an environment that is increasingly complex and unfamiliar.

While control rooms employ real-time information systems and graphical digital displays to keep board operators fully informed of production status and operating parameters, the physical plant outside the control room is often only minimally identified, forcing field operators to navigate a confusing labyrinth of pipes, vessels and instruments relying solely on their past training and experience.

Finally, consider the growing scale of maintenance, repair and overhaul activities. More and more facilities are moving to a system where shutdowns and turnarounds are performed less frequently in order to maximise plant throughput and profitability. As a result, the scope of a single shutdown/turnaround is expanding significantly, involving more tasks and more people. Visuals can be extremely helpful when employees are working outside their normal area. Equipment visuals can contribute to improved job performance for contractors who are unfamiliar with the area or are seldom engaged in site equipment work.

This added complexity reinforces the need for an information-rich work environment that "communicates" with the workers. Smart employers can improve the quality of workmanship and the quality of work-life for employees and contractors by making some relatively simple changes in the work environment. Focused use of equipment visuals are practical examples of some of these "simple changes."

Changing Work Force

As our industrial workforce ages and nears retirement, there are a number of improvements that cannot be deferred. Their younger replacements:

1. Are often fewer in number
2. Must come up to speed as fast as possible
3. Must master the ability to do critical tasks right, the first time and every time while in a steep learning curve.

The job of mentoring, training, and coaching typically falls on the shoulders of more senior, experienced operating and maintenance technicians. In many cases, the senior technicians may not be "skilled trainers" and employers may not have the luxury of time-based traditional approaches to training and skill building. The training/learning process must be improved – more effective in less time – and equipment visuals can make a significant contribution.

The aging workforce also presents additional workplace challenges. According to studies:

- The eyesight of a worker at age 60 diminishes and requires eight times more lighting to see clearly.
- Hearing also declines often due to the many years of working in high-noise workplaces.
- We also get shorter and stockier, causing our muscle strength to decreases by 20 percent by age 60.

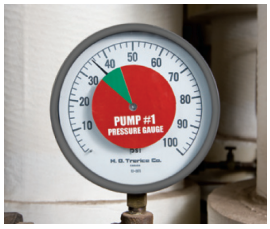
Applied visuals can go a long way to make the workplace friendlier and the job tasks easier to perform.

Types of Equipment Visuals

There is a wide variety of proven cost-effective and task-effective visuals for the petro-chemical industry. They mostly fall into the following categories:

1. Gauge marking and labelling
2. Equipment lubrication
3. Replacement parts identification
4. Equipment and component identification
5. Fluids and levels
6. Checklists and procedures
7. Condition monitoring
8. Positioning
9. Pipe and valve identification, content and flow
10. Lockout/Tagout

1. Gauge Marking and Labelling



Analogue gauges monitor, measure, and communicate a wide variety of information including temperature, pressure, vacuum, and flow. Guesswork is removed by labelling gauges with the names of the processes being monitored and their allowable ranges. Colour coding allowable ranges in green and red (danger) communicate conditions very rapidly.

2. Equipment Lubrication

Equipment requires lubrication, specifically the right lube, the proper amount and at the proper intervals. Pumps, motors, agitators, fans, valves, and bearing blocks are often damaged by under lubrication, over lubrication, or the wrong lube.

Labelling lube points to match a lube diagram ensures all points are located and identified. Each lube point should be labelled with:

1. Type of lube
2. The lubrication interval
3. Amount of lube required.

These three components are critical to error-proofing equipment lubrication and eliminating lubrication-related failures.

A second enhancement is a standardized lubricant color-coding system for lube containers, grease guns, and lube points on the equipment.

3. Replacement Parts Identification

Equipment often has field-replaceable service items or parts. These may include filters, belts, chains, O-rings, seals, bearings, etc. Applying part number labels on the equipment for these parts helps the technicians locate and verify the right parts for the equipment-specific application and saves travel time and extra steps locating the correct parts.

Labelling parts, their applications, the stock number/supplier information, min-max levels, and re-order points helps prevent errors and stock-outs in store rooms, warehouses, and supply cabinets. Parts labels can contain identifying information (part numbers and bar codes), supplier, OEM, and include a photo of the part to eliminate guesswork when retrieving or re-ordering parts.

4. Equipment and Component Identification

Equipment and component nomenclature is essential to managing the work order process and tracking equipment histories. Communications about the equipment, repair and maintenance histories are improved by labelling equipment and major components with highly-visible asset tag numbers and names.

5. Fluid and Levels

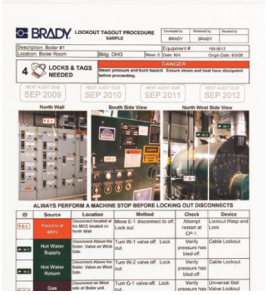
Levels of fluids in tanks, reservoirs, and vessels are often checked with installed sight glasses. Maintaining the cleanliness and functionality of these sight glasses should be part of the PM process.

Colour-coding can also make reading levels easier and more intuitive inspections.

- Green for normal level
- Red for levels that are too low or too high.

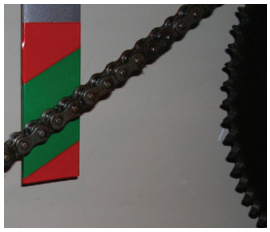
Examples of important types of label information:
Proper fluid types, capacity, high and low levels, when to read the level (running or not running), sample ports, and fill ports.

6. Checklists and Procedures



Procedures often become habit. Repetitive procedures as well as infrequently performed procedures are always subject to human errors and omissions. Checklists are brief and portable reminders of more detailed procedures or work instructions. Visual checklists are augmented with photos or illustrations of critical steps within the procedure. These visual checklists can then be indexed to the equipment when step-by-step numbering from the checklist is applied to the equipment using small numbered labels.

7. Condition Monitoring



Equipment conditions can sometimes be monitored by eyesight or by touch – based on the knowledge of what to look for or what to listen for.

- Labelling inspection points, direction of rotation, and indicating allowable chain slack are easily applied visuals.
- Temperature sensing labels also provide accurate, reliable, and continuous monitoring of component temperatures in protected environments.

More detailed condition monitoring is accomplished by more sophisticated methods: temperature measurement, infrared inspection, ultrasound inspection, vibration analysis, and oil analysis have gained popularity in modern maintenance and reliability programs. Labelling the exact spot where to take the readings or where to position the sensor will help facilitate consistent and accurate monitoring and measurements.

8. Positioning

Valves, levers, switches, and dampers all have to be in a prescribed position – on, off or partially open – to make the equipment or processes function properly.

9. Pipe and Valve Identification, Contents and Flow

Piping and valve identification is quite common in plants today. This type of labelling is a requirement in some processes. In many cases pipe and valve labelling will also lead to improved job performance in operations as well as in maintenance. Common visuals that include labelling are:

- Piping contents and hazards
- Direction of flow
- Source and destination (to and from)
- Valve identification
- Valve normal positions (open-closed).

10. Lockout / Tagout

Working on energised equipment often requires that it is locked and tagged out according to regulatory requirements and/or company policy. To start with, lockout points should be identified on equipment-specific lockout/tag out diagrams that are attached to the equipment. Each of these points should then be labelled according to the diagram. Labels should include:

- Type of energy source (electrical, compressed air, hydraulic, etc.)
- Numbered lockout sequence
- Lockout tags.

Incorporating Equipment Visuals in the Equipment Life Cycle

Applying visuals to existing equipment to improve operation and maintenance may be the biggest opportunity for improvement. However, when visuals are incorporated as part of the design/build/procurement/install/startup phases they immediately become part of the operating and maintaining expectations for the life of the equipment.

Equipment engineers, manufacturers, reliability engineers, and maintenance engineers are in excellent positions to define and apply visuals at the early stages of equipment projects. Design and procurement specifications should include the requirement for “applied equipment visuals” that will lead to error-proofing, operability, and maintainability, as well as hazard awareness and safety improvement.

Summary

An immense amount of time and energy has been devoted to the “visual factory” and the “visual workplace” in the quest to improve workplace communications and controls. Equipment visuals take those basic concepts one step further by applying visuals ON the equipment to communicate what is important in order to get us to pay attention. However, equipment visuals are much more than simply labelling and colour-coding machines.

The top priority of equipment visuals is that the proper equipment knowledge is applied to the proper place. Proper operations, proper maintenance, and proper equipment conditions must be verified as accurate by those who are applying equipment visuals.

Start by applying the equipment visuals to your most critical, problem-prone, and high-cost at-risk equipment. Be careful to avoid “visual clutter.” Every applied equipment visual must have an important purpose, whether it is improving operating and maintenance tasks, improving communications, improving safety or reducing errors. Link these visuals to the applicable operating, maintenance, and safety procedures, in addition to the coaching, training, and skill building for the present and future of your workforce.

Brady offers a variety of visual workplace solutions for the industrial environment to enhance equipment operability and maintainability. These systems, including software, printers and accessories, enable customers to create equipment visuals on-demand. For more information on Brady’s products, visit **www.bradyeurope.com**

This whitepaper was written for Brady Corporation by Robert M. Williamson, a consultant, and author for maintenance excellence and equipment reliability.

Brady Corporation

Our mission is To Identify and Protect Premises, Products and People

Company Overview

BRADY was founded in 1914 in Eau Claire, Wisconsin, as W.H. BRADY Co., and renamed BRADY Corporation in 1998. The company began selling products internationally in 1947. In 1984, BRADY went public, with stock trading on the Nasdaq Stock Market, and in 1999, moved trading of its stock to the New York Stock Exchange, where it trades under the symbol BRC. The company's global headquarters is in Milwaukee, Wisconsin.

Brady manufactures and markets:

- products for identification and safety applications such as signs and markers, and printing systems and software to produce identification products on site and on demand.
- products for wire identification, including labelling materials and tools for wire and cable marking in the electrical and telecommunication markets
- high-performance identification products, including labels and signs that remain legible and highly adhesive even in harsh environments
- identify people and enhance security by ensuring the right persons are in the right places at the right time

Operations – Some facts:

- 6500 employees around the world
- Operations in 29 countries
- Distribution in more than 100 countries through more than 4,400 distributor partners

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