Trade School Newsletter

The world's only engineering flyer for plant operators & maintainers, that cuts time, money & resource waste.

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Volume 1 Edition 8 topics

Regular features

Asset Management

The CMMS user

Computerised **M**aintenance **M**anagement **S**ystems are part of the modern maintenance department's tool kit. It is as important to the business of maintenance as a screw diver is to a fitter or an electrician. Without it you can only achieve average results.

The difference between a screwdriver and a CMMS is that only one person can use a screwdriver, whereas a CMMS requires everyone to use it. When two or more people share communication it becomes necessary to check that the words used mean the same to both.

Patrick Forsyth in his book 'Communicating with Staff' says to use clear words ("…the right words, the right phrases ") and straightforward words ("short words, short phrases and short paragraphs ") so "...that good communication can contribute to the achievement of whatever results are planned".

Some words actually cause confusion. Words like "BREAKDOWN", "CORRECTIVE", "MODIFICATION" commonly appear as Job Types on maintenance work orders. They are difficult concepts to grasp and may not mean a lot to an operator who has to fill out a work request.

A ship's captain doesn't give confused orders to his helmsman. He uses words like "dead stop', 'hard to port', 'come about' – simple words with a clear meaning.

If people have to enter data into a CMMS that is used later by others try using words that mean the same to everyone. The table below has some examples.

Instead of	Try using
Breakdown	Does not work Stopped dead Won't go
Corrective	Works poorly
	Not as good as new
Modification	Needs to be better;
Capital	All brand new

Simple words will reduce training, improve input accuracy and make implementation faster.

Performance Reviews for the Crew

Mid-year and annual performance reviews are a useful chance to talk to each person in the crew individually. To give feedback, support and encouragement Does your company use a structured approach to discuss performance issues with its people?

Textbooks on organisation systems recommend a formalised procedure when discussing work performance. To reduce interviewer bias, and short-term-memory syndrome, a form listing all the performance criteria relevant to a position, with clear standards to be achieved, is developed.

Down the left side of the form is recorded the necessary criteria for the job and the performance standards required. For example a trade position may have 'Trade skills' as a criteria. A satisfactory assessment might be to 'Use manual skills, tools and knowledge to rebuild machinery to original specifications without excessive supervision'.

The rating scale is across the top of the page. Finding the right words for the rating is hard. To get the best result, the appraisal experience should be honest, fair and friendly.

It is important that the rating system be verifiable. Words like 'good' and 'average' should be replaced with a recognised level of accomplishment. 'Good' could be replaced with 'Betters standard more than half the time'. Use up to 10 criteria on the form and five grading levels. Leave space under each criteria for written comments.

A review meeting is just that – a time to spend considering past performance, telling them how they have been seen to work and together working out ways to strengthen any weaknesses.

Everything that is said in a review meeting must be fact. You need to talk about real situations, real happenings and real effects. Only then can people see that you are being straight and honest with them. It means that you have to do your homework before the meeting.

You can use the form to canvas the views of other supervisory people that work closely with the person being reviewed. Let them use the form to rate the person. Again they must be honest and considerate, but accurate. You can then check your own rating against theirs and investigate discrepancies.

The review process is a great way to spend 'quality time' with the people in your operation. If it is used as a tool to help people see where they are now and then to show them where they need to go, it becomes a useful exercise for all.

ISOLATION VALVES FOR DIFFERENT SERVICES

THE PURPOSE OF A VALVE

The purpose of a valve is for isolation or regulation. Isolation valves seal the fluid off on one side of the valve. Regulating valves meter the flow through the body.

THE CONSTRUCTION OF VALVES

The essence of valve operation is closing or opening a gap by moving one surface against another. This occurs within the valve body. In the case of manual and actuated valves, a stem sticks out of the body and has to be sealed to prevent leakage. Figure 1 shows a variety of valve and seat sealing arrangements.

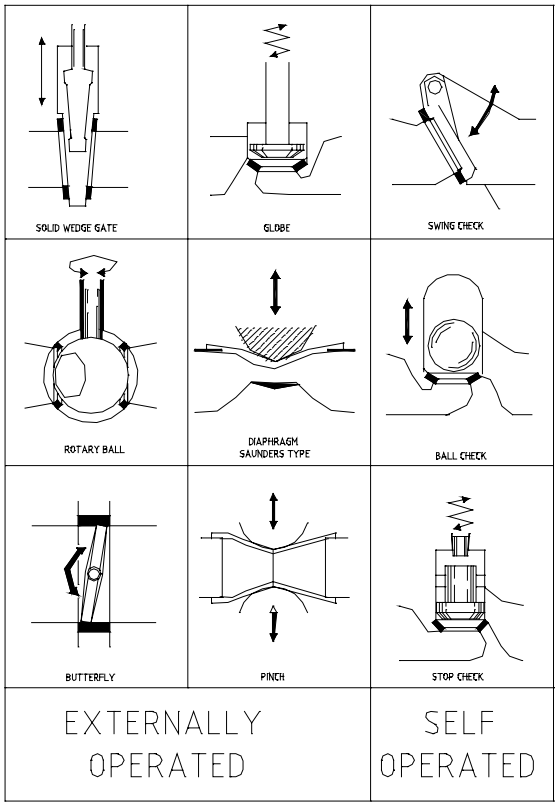

FIGURE 1 A range of valve types

Valves are constructed to manufacturing standards that specify performance requirements for the materials used in the valve. The completely assembled valve is also required to pass leakage tests. Two widely used leakage standards are API 598 (American Petroleum Institute) and BS 6755 (British Standard).

ACCEPTABLE LEAKAGE RATES FROM VALVES

Both standards accept some leakage from certain styles of valve. Table 1 shows what is acceptable in API 598.

Resilient valves are those with one or both sealing surfaces made of plastic or rubber. When a resilient valve is tested with liquid no leakage is allowed during the test period. If tested with a gas one bubble is allowed during the test.

Size Range Inches	Resilient Seated Valves	Metal Seated Valves Except Check		Metal Seated Check Valves	
		Liquid	Gas	Liquid	Gas
≤ 2	0	0	0	0.18 in^3 (3 cm^3)	1.5 std ft^3 (0.042m^3
2 ½ - 6	0	12	24		
8 - 12	0	20	40		
≥ 14	0	28	56		

TABLE 1 API598 leakage rates

The test pressure used for most valves is 110% of the maximum allowable pressure for which the valve is designed at 38°C (100°F). But for butterfly valves it is 110% of the design differential pressure. This means when ordering butterfly valves, you must specify the maximum in-service pressure. The differential pressure rating is the ability to hold pressure from one side of the valve to the other. The allowable pressure depends on the materials from which the valve is made and the stresses allowed in the materials.
The test pressure is held on the valve for a specified period of time defined in the applicable standard. Table 2 is from API 598 for a high-pressure closure test.

Minimum test duration in seconds for closure test.		
Valve size (inches)	Check valve	All other valves
≤ 2	60	15
2 ½ - 6	60	60
6 - 12	60	120
≥ 14	120	120

TABLE 2 API598 pressure holding times

More demanding standards are available. An example is API 6D, which allows no visible leakage during the test period. However manufacturers will find it difficult and costly to achieve such a standard for metal to metal seat valves. Valve manufacturer's catalogues specify which standards they meet.

FIRE RATED VALVES

Fire testing exposes valves in the closed position, filled with water under pressure, to flames producing a temperature near the valve of 760°C – 980°C for a 30-minute period to establish a leakage through the valve to atmosphere. After cooling the valve is pressurised with water to assess the pressure containing capacity of the valve body and seats. If you require fire rated valves ask for test documentation.

CONSIDERATIONS WHEN SELECTING VALVES

What the tables above do not say is that metal seated valves larger than 2-inch may leak from day one and get progressively worse with use. For many services that may not be a problem. However for corrosive, hazardous and

toxic gases and liquids it is important to know that most metal seated valves leak. Picking the right valve type is critical for safe operation.

The tests do not consider effects such as distortion from 'water' hammer, high seal face open – close cycles, high temperatures and temperature differentials causing thermal expansion, chemical degradation like corrosion of sealing faces and 'wire draw' across slightly open valves. One option for more reliable isolation using all metal valves is to use a double block and bleed configuration. Two valves are installed slightly apart and a third valve is used to drain the pipe between them.

The other location that can leak is at the valve stem. Check that the packing or sealing o-ring(s) is suitable for the service. An example is where the manufacturer installs packing for hydrocarbons but you require the valve for process chemicals. In this case change the packing to the right type for the process.

Beware of valve stems that are exposed to the process. If a valve stem extends into the process fluid when closed, and raises when open, there will be a thin smear of chemical clinging to the stem as it wipes past the seal. The raised stem is now exposed to outside world conditions. The process chemical may dilute with moisture in the air or from hose-downs and attack the stem or it may dry on the stem and cut the seal when next lowered.

Other operating considerations include:

- whether the lines are to be pigged (use full bore valves)
- liquid thermal expansion causing pressure build-up between closed valves (install pressure bypass valving)
- position indicators to show close- open position
- back seating to prevent stem leakage when valve is open
- product build-up on seat faces (stroke the valve regularly)
- pressure loss minimisation (use full bore valves).

Mike Sondalini
Maintenance Engineer

POLYETHYLENE – ITS PROPERTIES AND USES

WHAT IS POLYETHYLENE?

Polyethylene (PE) is a plastic. It is made by combining single carbon atoms together to create long chains of carbon atoms. The long chains are called macromolecules. Attached to each carbon atom are usually two hydrogen atoms. Figure 1 shows how the macromolecule of polyethylene is arranged.

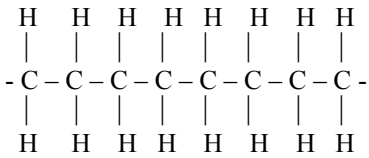

FIGURE 1 PE macromolecule carbon chain

PE belongs to the family of plastics called thermoplastics. These plastics have weak forces that attract the macromolecules together. The other family of plastics is the thermosets. In these the hydrogen atoms are occasionally replaced with other atoms that attach to neighbouring chains, locking them together. The thermoplastics can be melted and reshaped but the thermosets can only be used once.

The process of using solvents and heat to convert from single atoms to a string of thousands of atoms long is called polymerisation. During polymerisation many carbon chains are created at the one time. When PE is molten the long chains are mobile but upon cooling, the long chains intertwine and lock together. Much like when spaghetti is boiled and let cool.

The density of PE depends on the process used to make it. One method produces low-density (LDPE) while a high density (HDPE) results from the other. The plastic's density can be further modified to produce medium density (MDPE) and ultra high molecular weight (UHMWPE) products. The properties of each type of PE depend on the shape and length the carbon chains and how closely they compact.

THE STRUCTURE OF POLYETHYLENE

The carbon chain length and extent of branching greatly affect the properties of the plastic. Figure 2 shows the different structures of the macromolecules for LDPE and HDPE.

The amount of side-chain branching varies the closeness that molecules can come together. Closely compact chains give more rigid and solid plastics. Occasionally the molecules will lie side by side. This creates a harder clump known as a crystalline alignment. Plastics with high amounts of crystalline arrangements are harder and stronger but more brittle. UHMWPE chains have few branches and are 10 – 20 times longer than HDPE. This permits development of many more crystalline areas than the lower density PE's. Randomly arranged chains without order makes an amorphous structure. Examples of each structure are shown in Figure 3.

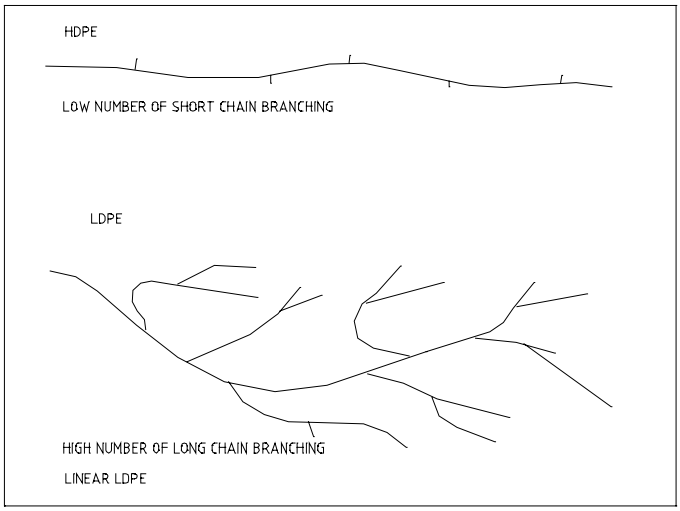

FIGURE 2 Macromolecule structural shapes

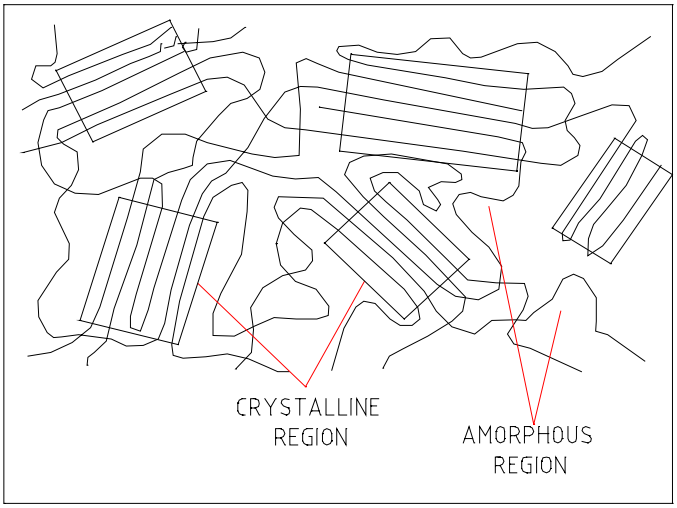

FIGURE 3 Crystalline and amorphous regions

PROPERTIES AND USES

The degree of branching and crystallinity in PE produce variations in behaviour and properties. Table 1 gives an overview of the differences between types of PE.

TYPE	DENSITY Specific Gravity	DISTORT TEMP ^{O}C	TENSILE STRENGTH N/mm^2	ABRASION RESIST
LDPE	0.91 – 0.92	40 - 50	170	Soft
MDPE	0.93 – 0.94	60 - 70	275 - 450	
HDPE	0.94 – 0.96	70 - 90	Over 625	
UHMWPE	> HDPE	> HDPE	> HDPE	Excellent

TABLE 1 Comparison of properties

The lower density PE's have good toughness (ability to deform without breaking) and excellent elongation (ability to stretch) with LDPE stretching up to 6 times its original length before breaking. This makes them a useful plastic for moulding and extruding in shapes of bottles, tanks, sheets and pipes. UHMWPE is used for machinery parts where a high wear, low friction material is required.

In its natural form PE is clear and goes white and translucent as the amount of crystallinity increases. It is used in stretch films, plastic bags and plastic bottles. Coloring agents can be added. It degrades from ultraviolet radiation. When used in sunlight 2 - 3% carbon black powder is added. Life expectancies in outside conditions of over 25 years are attainable.

Chemical resistance properties of PE are excellent, covering a wide range of chemicals. Check compatibility with the supplier.

A major consideration with the use of PE is its tendency to exhibit environmental stress cracking (ESC). ESC is sudden failure induced by internal stresses from outside loads or fabrication strains. Often involving containment of liquid hydrocarbons and man-made soaps and oils. ESC decreases as carbon chain entanglement increases. It is more likely in HDPE than LDPE. ESC tests are available and recommended if using PE to store previously undocumented chemicals.

WELDING POLYETHYLENE

Since PE is a thermoplastic it can be melted and joined. When welding, the temperature is raised above the melting point (110 – 135^{o}C) to a temperature of about 250^{o}C using a hot air gun for hand welding or a heated plate for butt-welded pipes. When hand welding PE a filler rod is pushed into the melt. When butt-welding pipe the two ends are heated and pushed together for 10 to 15 seconds.

At the melted surface the carbon chains intertwine and cool. Successful welds need a sufficiently high temperature and pressure at the melted surfaces for a long enough time to let the carbon chains mesh well. A 'cold weld' occurs if the melt temperature is too low. A weak failure prone weld results which breaks away from the parent material.

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What the book says

Book being reviewed is "MAINTENANCE PLANNING AND SCHEDULING HANDBOOK" by Doc Palmer and published by McGraw Hill.

The book begins with the sentence - "The Maintenance Planning and Scheduling Handbook shows how to improve dramatically the productivity of maintenance." But what else would you expect the author to say? However the book soon starts quoting verifiable productivity improvements of 50% above the results achieved when not using planning.

Doc Palmer separates planning and scheduling. For each he gives 6 principles to work by. He sees planning as an entirely distinct step to scheduling. The planner is located separate to the maintenance department so he cannot be diverted from the job of planning by sudden problems.

The planner is not the scheduler. The maintenance supervisor schedules. The planner provides a complete work package – purchased materials, tool list, procedures, drawings, past equipment history, job times, manning requirements and external resource requirements such as cranes – and then walks away to prepare the next work order.

Breakdown jobs cannot be planned and Doc advises that breakdowns go directly to the maintenance supervisor to run with. The planner does not become involved in breakdowns or in any job once started. The planner is there to get ahead of the day-to-day work so that fresh work is always prepared for the crew before they finish their current jobs.

If the crew find a problem once a planned job is started the crew solves the problem themselves without involving the planner. The planner is advised of the problem in the report when the work order is returned. He makes a note in the plant records so he can plan and prepare for it next time.

Productivity is maximised because all the planning, parts and information is provided and the tradesmen can be immediately put onto the tools to do the job.

Doc also indicates that a good planner has particular attributes that are critical for success and provides a useful list of them in the appendix to his book.