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**AMERICAN SOCIETY OF MECHANICAL ENGINEERS,  
B31.8 COMMITTEE INTEGRITY MANAGEMENT STANDARD SUPPLEMENT (B31.8S)**

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**ABSTRACT**

Under the auspices of the American Society of Mechanical Engineers (ASME), a new standard supplement has been produced to aid operators in the development and implementation of an integrity management program. This new standard supplement will outline the technical requirements for implementation of an operator's integrity management plan as well as the programmatic elements overall.

Historically, integrity management has been an integral part of pipeline operations. Contained throughout ASME B31.8, integrity management requirements are specified. One purpose of this new supplement is to formalize a more deliberate process for the management of integrity and to push adoption of an industry consensus standard by the Office of Pipeline Safety.

An ad-hoc task team was assembled earlier this year to develop the standard supplement. The task team consists of members from the Office of Pipeline Safety (OPS), from the National Association of Pipeline Safety Regulators, and from the gas transmission and distribution industry.

With an opportunity to create a new standard, the task team was able to fundamentally and deliberately rethink the process and the protections provided. The standard supplement is the repository for twenty technical studies and reports completed by a variety of scientific and technical organizations. These studies and reports provide the technical platform for the standard supplement. It is anticipated that the standard will serve as a "hub" for many other standards, eight of which are presently under development.

The B31.8 code was the predecessor to the pipeline safety regulations, which were first promulgated in 1970. The code is an international code and is approved by the American National Standards Institute (ANSI). It was felt that an ASME consensus standard would be the best home as the companion to the proposed regulations due to the strict policies of both ASME and ANSI for public comment, due process, and technical justification.

The standard supplement provides guidance for two methods of compliance, a prescriptive track and a performance track. The prescriptive track will be very conservative but easier to implement. The performance track will be more flexible but will require significantly more data to implement. Within the standard supplement, the operator would have the option of following either track.

This new standard supplement represents a new way for regulations, research and standards to be coordinated. It provides for performance based regulations referencing technically based standards that are developed from focused research.

**INTRODUCTION**

The supplement is a non-mandatory supplement to the ASME B31.8 standard. It is available for use by all code users but not required by B31.8. It is anticipated that any jurisdictional authority such as the US DOT may incorporate the standard by reference into their regulations. In this manner the supplement would become mandatory to the jurisdictional authority.

The standard outlines the technical requirements for implementation of an operator's integrity management plan.

**DEVELOPMENT OF THE DOCUMENT**

In order to expedite the development of the supplement, an ad-hoc task team was assembled. The team directed the necessary supporting research, wrote the supplement and helped orchestrate the development of supporting standards. The team was made up from the following constituencies:

- Office of Pipeline Safety
- National Association of Pipeline Safety Regulators
- Operators of gas transmission pipelines
- Researchers and Scientists

The team solicited input and comments from their constituencies in order to make the document as useful, usable, and technically correct as possible. The standard is published as an ANSI consensus standard.

**RESEARCH SUPPORT OF THE DOCUMENT**

In order to base the standard on the most current scientific finding available, many research activities were commissioned. It was decided to get the best minds in the business involved in the research and the resultant report writing. A total of 18 research reports were funded with most finished in 2001. The remaining research is expected to be completed in 2002. The reports supporting the technical aspects of this standard have been published and available for public review.

**TERMS AND DEFINITIONS**

A comprehensive terms and definitions section is included to minimize confusion and inconsistency of application. These terms and definitions are consistent with other ASME standards. In addition the terms and definitions are consistent to other standards to the degree possible.

**GUIDELINES AND EXAMPLES**

The document has guidelines and examples as well as standard text. It was agreed between the task-team and the standards group that use of guidelines and examples would add value to the user, even though this type of structure is not widely used. It is expected that more traditional standard form and format will be used in future editions of the document.

**INTEGRITY MANAGEMENT PROGRAM**

The standard is structured as a program with five distinct elements or plans. Each plan is described in the standard in detail. A graphically representation is shown below in Figure 1.

**Integrity Management Program Elements**



**Figure 1 – Integrity Management Program Elements**

The Integrity Management Plan is the outcome of applying the process depicted in Figure 2 below. The plan is the documentation of each of the steps and supporting analyses that are conducted. The plan will include prevention, detection and mitigation practices and a schedule that considers the timing of the practices employed.

The Program Evaluation Plan is the plan addressing the collection and analysis of performance information. This analysis is used to improve the Integrity Management Plan.

The Communication Plan is the plan that details the elements and methods to communicate about the Integrity Management Program to affected stakeholders including employees, the public, emergency responders, local officials and jurisdictional authorities.

The Management of Change Plan is the plan that addresses the systematic process used to implement changes to the pipeline system design, operation or maintenance.

The Quality Control Plan is the plan that outlines the necessary documentation for integrity management purposes.

**THREATS TO PIPELINE INTEGRITY:**

Based on the analysis performed on the data submitted to the U. S Department of Transportation on causes of pipeline incidents, 22

distinct threats have been identified. The standard addresses each of the 22 threats to pipeline integrity. For ease in understanding, the threats were grouped into nine major categories. An analysis is performed on each of the nine categories within the integrity assessment process. Each of the nine categories has a time element that aids in the determination of initial and subsequent inspections. The time elements are Time Dependant, Stable and Time Independent.

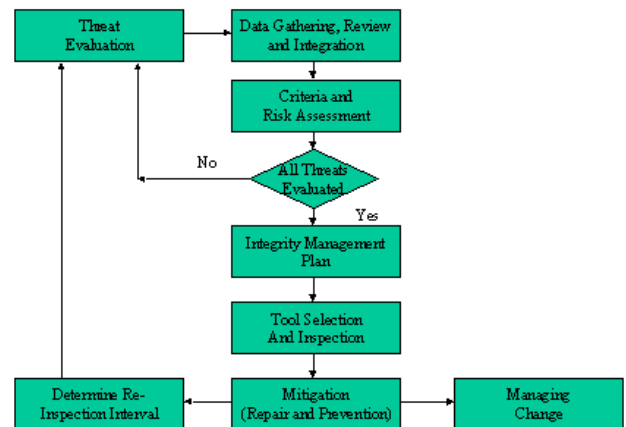
**PRESCRIPTIVE VS. PERFORMANCE:**

The standard provides for two tracks in the approach. The two tracks are prescriptive and performance. Prescriptive is very conservative but easier to implement. Performance is more flexible but requires significantly more data and analysis. The operator can select either program for the entire system, each segment, or each threat within a segment.

**INTEGRITY MANAGEMENT PLAN PROCESS**

The process identified in the standard is illustrated below. For each of the nine threat groups, the operator would gather, review and integrate the data necessary to perform a risk assessment. The assessment is made by comparing the data analysis results against specified criteria. The assessment results in an understanding of what must be done to determine integrity. From the assessment, a plan is developed to determine the integrity. The appropriate tool(s) are selected and the inspections are done. As a result of the inspections, the appropriate repair and prevention activities are implemented and the re-inspection interval determined.

**Integrity Management Plan Process**



**Figure 2 – Integrity Management Plan Process**

**INTEGRITY MANAGEMENT PROGRAM PRINCIPALS**

Integrity must be built into the pipeline system from initial planning, design and construction. The program is continuously evolving and must be flexible. Information integration is a key component. Risk assessment is a key element. Assessing risk to pipeline integrity is a continuous process. New technology should be evaluated and implemented as appropriate. Performance measurement of the system and program must be an integral to the integrity management program. Senior management commitment is required and must be demonstrated.

**OTHER STANDARDS UNDER DEVELOPMENT:**

In the process of developing this standard it was determined that other supporting standards would be needed. Various standards

organizations were contacted and agreement reached on whom would take the lead for which standard. Research was conducted to form the technical base and the standard development was initiated. A partial list of these standards and the sponsoring technical organization is given below:

In-line ‘Inspection Systems– this standard addresses the quality of the entire inspection process, as an umbrella standard it will focus on methodology, tool capability and expectations calling up other standards for inspection assurance and operations and personnel qualifications. API

Direct Assessment, External – this standard addresses the process of direct assessment for external corrosion of pipe. NACE, TG 041

Direct Assessment, Internal – this standard addresses the process of direct assessment for internal corrosion of pipe. NACE, new standard (RP0175 was withdraw)

Direct Assessment, SCC – this standard addresses the process or direct assessment for stress corrosion cracking of pipe. NACE, separate clause additions to TG 041

Pressure Testing – the material addressing pressure testing of in-service was incorporated into the ASME B31.8 standard. ASME

Dent and Gouge Assessment – the material addressing dent and gouge assessment was incorporated into the ASME B31.8 standard. ASME

ILI Operations – this standard addresses the communications and other expectations for operators and service providers for the various tools in the market place before, during and after inspections for various threats. NACE, RP0102

ILI Personnel – this standard addresses the qualification of personnel interpreting the in-line inspection results. ASNT

## **GATHERING, REVIEWING AND INTEGRATING DATA**

The operator must develop a plan for collecting the data that is required. Minimum data sets are delineated in an appendix for the prescriptive program and must be determined for the performance program. Where data is missing, the operator must assume that the threat exists. The standard also lists potential sources of where to locate data.

It is important to note that the age of the data may invalidate its applicability and that data resolution and units must be reconciled. Integration of data provides better analysis and considers new data into the assessment while preventing incorrect conclusions

## **RISK ASSESSMENT**

As we all know, risk is the product of likelihood and consequence. The operator must determine the risk for each threat (22) or group of threats (9). Risk assessment of the threats provides a measure that supports integrity management process. Various approaches can be used however most common for prescriptive program is the use of Subject Matter Experts or Relative Risk Models.

Risk analysis for the prescriptive approach is primarily used to prioritize pipeline segment assessments. Stated investigation timelines and re-inspection intervals apply to prescriptive approach.

Several characteristics contribute to the overall effectiveness of risk assessment. Risk assessment is an on-going process where continuous improvement is expected. The process needs to be reviewed to ensure accurate results. Additional data may be required while performing risk assessment. The operator must consider both overall risk and risk of single elements. Specific threats may be eliminated from risk assessment if the history and data supports such elimination.

Risk assessment is also dependent on the past mitigation level, with more rigorous mitigation providing the opportunity for less frequent assessment. Risk analysis results must be validated to insure the process or approach in general and the plan specifically.

## **INTEGRITY ASSESSMENT**

Based on the priority determined from risk assessment, appropriate integrity assessments must be performed. For the prescriptive approach, assessment options are listed in the appendix. Applicability of the assessment options is also provided in the appendix as well as in the body of the standard.

Assessments may find indications for other threats that must be addressed. For example while looking for corrosion, the tool may find indications of third party damage. Once the assessments are complete, inspection and evaluation may be required to validate the assessments. For the prescriptive approach, only the listed assessment methods are expected to be used. The standard does however provide for alternative assessment methods.

The interval between assessments is prescribed in the standard where the operator chooses the prescriptive tract. These intervals are shown in Figure 3 below. For the Performance tract, the operator chooses the interval.

Table 8-1				
Integrity Assessment Intervals - Time Dependent Threats				
Prescriptive Integrity Management Plan				
Inspection Technique	Interval (years)	Criteria		
		At or above 50% SMYS	At or above 30% up to 50% SMYS	Less than 30% SMYS
<b>Hydrostatic Testing</b>	5	TP to 1.25 times MAOP	TP to 1.4 times MAOP	TP to 1.7 times MAOP
	10	TP to 1.39 times MAOP	TP to 1.7 times MAOP	TP to 2.2 times MAOP
	15	Not Allowed	TP to 2.0 times MAOP	TP to 2.8 times MAOP
	20	Not Allowed	Not Allowed	TP to 3.3 times MAOP
<b>In-line Inspection</b>	5	PF above 1.25 times MAOP	PF above 1.4 times MAOP	PF above 1.7 times MAOP
	10	PF above 1.39 times MAOP	PF above 1.7 times MAOP	PF above 2.2 times MAOP
	15	Not Allowed	PF above 2.0 times MAOP	PF above 2.8 times MAOP
	20	Not Allowed	Not Allowed	PF above 3.3 times MAOP
<b>Direct Assessment</b>	5	Sample of indications examined (*)	Sample of indications examined (*)	Sample of indications examined (*)
	10	All indications examined	Sample of indications examined (*)	Sample of indications examined (*)
	15	Not Allowed	All indications examined	All indications examined
	20	Not Allowed	Not Allowed	All indications examined

**Figure 3 – Assessment Intervals For Time Dependent Threats**

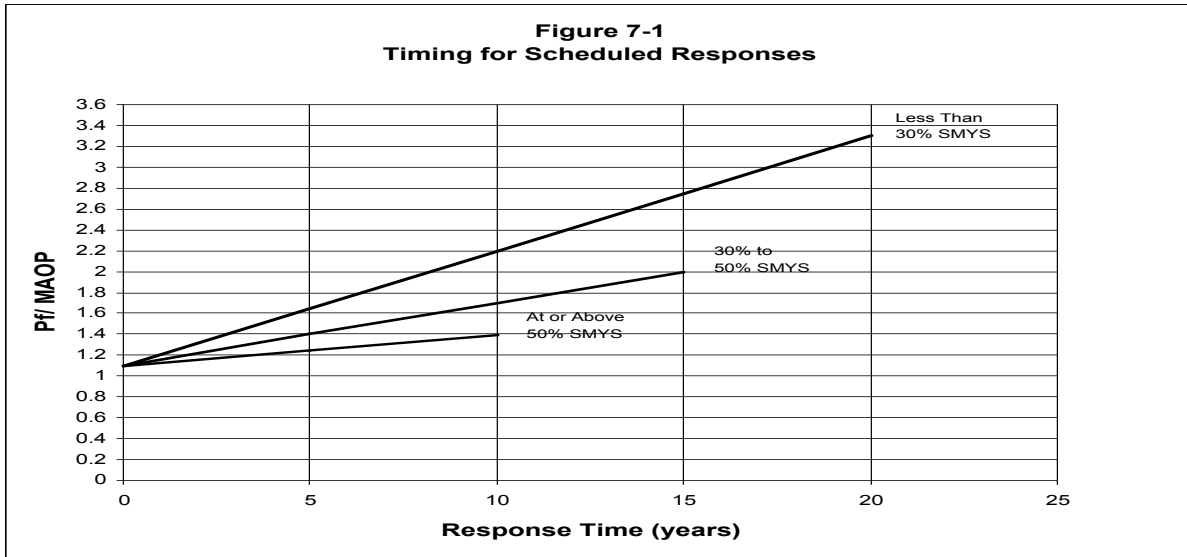
**RESPONSE TO INTEGRITY ASSESSMENT AND MITIGATION**

Responses to the assessments include examination, evaluation and mitigation (repair and prevention). Responses can be divided into three groups.

1. Immediate - Indication shows that defect is at failure point
2. Scheduled - Indication shows defect is significant but not at failure point
3. Monitored – Indication shows defect will not fail before next inspection

All assessments lead to a response to be conducted within a specified time frame. Responses cannot be extended for prescriptive approach. Responses can be extended based on sound engineering judgement for the performance approach. Figure 4 below, shows response times based on operating pressure.

Repair and prevention methods are discussed and include current industry practices. Prevention is also discussed in detail since it is an important proactive element of integrity management program. Prevention strategies (including intervals) should consider threat classifications. Some threats may not require re-assessment unless the facilities or operating conditions change.



**Figure 4 – Timing For Scheduled Responses**

**CONCLUSION AND RECOMMENDATIONS**

Under the auspices of the American Society of Mechanical Engineers (ASME), a new standard supplement has been produced to aid operators in the development and implementation of an integrity management program. This new standard supplement will outline the technical requirements for implementation of an operator’s integrity management plan as well as the programmatic elements overall.

One purpose of this new supplement is to formalize a more deliberate process for the management of integrity and to push adoption of an industry consensus standard by the Office of Pipeline Safety. The standard supplement is the repository for twenty technical studies and reports completed by a variety of scientific and technical organizations. These studies and reports provide the technical platform for the standard supplement. It is anticipated that the standard will serve as a “hub” for many other standards, eight of which are presently under development.

It is anticipated that the U.S. Department of Transportation will directly reference this standard supplement in their upcoming rulemaking. The B31.8 code was the predecessor to the pipeline safety regulations, which were first promulgated in 1970. The code is an international code and is approved by the American National

Standards Institute (ANSI). It was felt that an ASME consensus standard would be the best home as the companion to the proposed regulations due to the strict policies of both ASME and ANSI for public comment, due process, and technical justification.

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This new standard supplement represents a new way for regulations, research and standards to be coordinated. It provides for performance based regulations referencing technically based standards that are developed from focused research.

It is understood that the best way for continuous improvement of standards is the continual review and revision of the standard and the incorporation of new research and technological developments. It is therefore recommended that users and readers of this document should contact the B31.8 Section committee with any recommended changes that are technically based or which may add editorial clarification.