PlantManager SAGE

Licensing Packages

Equity Software® develops technology that supports informed decision-making and strategic planning for the safe and efficient operation of industrial assets. The fully integrated software supports all aspects of equipment lifecycle management by integrating the latest API and ASME codes and standards with the depth of Equity's engineering experience.

PlantManager SAGE® is a collection of mechanical engineering modules for conducting comprehensive evaluation and analysis of the design, condition, and compliance of new and in-service equipment. PlantManager SAGE is available exclusively through the PlantManager® 6.0 cloud-native platform.

DESIGN CODE

Design capabilities for pressure vessels, piping tanks, and fired heaters

Prerequisite

FITNESS-FOR-SERVICE

Conduct basic & comprehensive FFS analysis for new and in-service equipment

Prerequisite

MATERIALS

Material, physical, and strength properties database

SUPPLEMENTAL DESIGN

Additional design capabilities including property and wind determination

SPECIALTY FFS

Conduct level 3 FFS assessments, plus advanced fracture analysis, creep, and crack-like flaws

DETAILED STRESS ANALYSIS

Improve structural reliability with stress analysis of shells, nozzles, pipes, and elbows

FLUIDS & HEAT TRANSFER

Consider process, temperature, heat transfer, and fluid properties for welding repairs

Choose the combination of mechanical engineering modules that best suite your project or facility goals. Please note that the design code and fitness-for-service modules are prerequisites for all subscribers.

EQUITY SOFTWARE

Design Code

This collection of modules offers design capabilities for the components and equipment listed below. A subscription to Design Code is a prerequisite for all other PlantManager SAGE packages.

Pressure Vessels, Components (ASME VIII-1 Part UG, ASME VIII-2 Part 4.5, or ASME I Part PG)

SHELL - In-service or new design evaluations of pressure vessel shell sections are conducted in accordance with ASME VIII-1 Part UG or Appendix 1-1, ASME VIII-2 Parts 4.3 or 4.4, or ASME I Part PG. This includes evaluations for lines of support (stiffening ring) and the use of ASME VIII-2 factored load combinations as specified in Parts 4 or 5.

NOZZLE - In-service or new design evaluations of pressure vessel nozzles are conducted in accordance with ASME VIII-1 Part UG, ASME VIII-2 Part 4.5, or ASME I Part PG. This includes assessing components such as the vessel shell, nozzle neck, nozzle forging, external reinforcing pad, internal reinforcing pad, studded connections, butt welds, and fillet welds.

FLANGE - In-service or new design evaluations of pipe or pressure vessel flanges are conducted in accordance with ASME B16.5 or ASME B16.47 for pressure rating, ASME VIII-1 Appendix 2 or ASME VIII-2 Part 4.16 for allowable stress, and WRC 538 for yield stress. This includes evaluating both custom and standard ASME B16 flange geometries. The configurations assessed may include identical flanges, non-identical flanges, flange and blind, or exchanger (tubesheet) flanges. Additionally, an optional Rodabaugh (shell discontinuity analysis) evaluation is available.

TUBESHEET - In-service or new design evaluations of ASME shell and tube exchanger tubesheet configurations are conducted in accordance with ASME VIII-1 Part UHX, ASME VIII-2 Part 4.18, or TEMA.

BHEAD - In-service or new design evaluations of Type B, C, or D spherically dished bolted heads, with or without backing rings, are conducted in accordance with ASME VIII-1 Appendix 1-6 or ASME VIII-2 Part 4.7.

NCPV - In-service or new design evaluations of non-circular pressure vessels are conducted in accordance with ASME Section VIII-1 Appendix 13 or ASME VIII-2 Part 4.12.

FLANGERATE - In-service or new design evaluations of standard pipe or pressure vessel flanges are conducted in accordance with ASME B16.5 or ASME B16.47 flange ratings.

BELLOW - In-service or new design evaluations of unreinforced, reinforced, or toroidal bellows expansion joints are performed in accordance with ASME VIII-1 Appendix 26, ASME VIII-2 Part 4.19, or EJMA standards. These evaluations also include assessments for column instability and fatigue.

OFLATHD - In-service or new design evaluations of a flat head with an integral opening that exceeds one-half of the head diameter are conducted in accordance with ASME VIII-1 Appendix 14 or ASME VIII-2 Part 4.6.

CLAMP - In-service or new design evaluations of clamp-type flanged connections used in piping or pressure vessels are conducted in accordance with ASME VIII-1 Appendix 24 or ASME VIII-2 Part 4.17.

RFLANGE - In-service or new design evaluations of rectangular flanges are conducted in accordance with ASME PVP “Bolted Flanged Connections for Non-Circular Pressure Vessels.”

STRAN - In-service or new design evaluations of cone-to-cylinder knuckle transitions or junctions are conducted in accordance with ASME VIII-1 Appendix 1-5 or 1-8, or ASME VIII-2 Parts 4.3 or 4.4.

PRELIEFD - New pressure relief device (PRD) sizing or existing PRD rating capacity evaluation is conducted in accordance with API RP 520. This includes evaluations using the original RP 520 methods, Direct Integration (Annex B), or Omega (Annex C). The process also involves reaction force stress analysis.

Design Code Continued

Pressure Vessels, Equipment (ASME VIII-1, ASME VIII-2, TEMA)

HVESS - In-service or new design evaluations of complete horizontal vessel equipment are conducted in accordance with ASME VIII-1, including Zick's analysis, or ASME VIII-2. This evaluation covers components such as pressure boundary shell sections, saddle supports, saddle reinforcing rings, and external pressure reinforcing rings. Additionally, supplemental saddle section evaluations are performed in accordance with TEMA.

EXCHANGER - In-service or new design evaluations of complete heat exchanger equipment are conducted in accordance with ASME VIII-1 or ASME VIII-2. This includes assessments of components such as shell side and tube side shells, heads, cover plates, flanges, tubesheets, tubes, and internal floating heads. Tubesheets may also be evaluated in accordance with TEMA standards.

TOWER - In-service or new design evaluations of a complete skirt-supported vertical pressure vessel are conducted in accordance with ASME VIII-1 or ASME VIII-2. This includes assessments of pressure boundary shell sections, support skirts, internal heads, conical shell transitions, and reinforcing rings. The evaluation also considers occasional loads due to wind or earthquakes, referencing ASCE 7 or NBCC. Additionally, ASME VIII-2 factored load combinations are applied, and the base plate is evaluated for structural integrity.

Piping (ASME B31.1, B31.3, B31.4, or B31.8)

APIPE - In-service or new design evaluations of pipe sections are performed in accordance with ASME B31.1, B31.3, B31.4, or B31.8, and for boiler tubes in accordance with ASME Section I. High-temperature evaluations are conducted following ASME B31.3 Appendix V. Additional evaluations include branch reinforcement, pipe span deflection considering widespread or localized metal loss, blind flange or blank assessments, and ASME B31.J stress intensity factors calculations.

PCLASS - The recommended minimum required pipe thickness for user-defined standard pipe classes, considering a range of nominal diameters and operating conditions, is determined in accordance with ASME B31.1, ASME B31.3, ASME B31.4, or ASME B31.8.

Tanks, Equipment

TANK - In-service or new design evaluations of a complete flat-bottom storage tank are conducted in accordance with API 650 or API 653. This includes assessments of the tank shell courses, bottom plates, annular plate, roof, top corner joints, intermediate stiffeners, and tank anchorage. Evaluations also account for occasional loads due to wind or earthquakes and include internal or external pressure assessments according to API 650 Annex F or Annex V.

Fired Heaters (API 530)

RP530 - In-service or new design evaluations of fired heater tubes are conducted in accordance with API 520. This includes FFS assessments for creep damage or r emaining life according to API 579-1/ASME FFS-1 Part 10. Additionally, probabilistic risk assessments are performed to estimate the remaining life of the tubes.

STACK - In-service or new design evaluations of steel stacks are conducted in accordance with ASME STS-1.

Fitness-for-Service (FFS)

The modules within this licensing package provide users with all the tools for conducting basic and comprehensive fitness-for-service (FFS) analyses of new and in-service equipment. A subscription to FFS is a prerequisite for all other PlantManager SAGE packages.

APIFFS - An FFS assessment can be conducted for pressure vessels, piping, or tank shell sections (Type A or Type B, Class 1 components) in accordance with the API 579-1/ASME FFS-1 standard. Both Level 1 and Level 2 assessments are available for all identified damage mechanisms, providing a range of evaluation depths. Additionally, probabilistic risk assessments are offered for select damage mechanisms to provide a more detailed risk-based analysis.

APIFFSB - FFS assessment for nozzles and flanges (Type B, Class 2 components) is conducted in accordance with API 579-1/ASME FFS-1; currently only available for Part 3 brittle fracture screening and Part 4 general metal loss evaluations.

B31G - FFS evaluation of local metal loss in pipeline or pipe sections is conducted in accordance with ASME B31.G.

BURSTP - Burst pressure estimation for cylindrical and spherical shells is conducted using Svensson's method, as outlined in his 1958 paper from the *Journal of Applied Mechanics*, "The Bursting Pressure of Cylindrical and Spherical Vessels." Additionally, the probability of failure is evaluated based on statistical distributions, referencing methodologies from the *Journal of Pressure Vessel Technology* in the article "Strength Model Uncertainties of Burst, Yielding, and Excessive Bending of Piping."

HETVIB - In-service evaluations of shell and tube heat exchanger tube flow-induced or acoustic vibrations are conducted in accordance with TEMA or the Heat Transfer Research Institute (HTRI). This includes assessing various vibration criteria such as fluid elastic whirling, turbulent buffeting, vortex shedding, collision and baffle damage numbers, and acoustical vibration. Evaluations are simultaneously performed for inlet, outlet, and center locations.

PIPERETIRE - In-service pipe span deflection and stress evaluations are conducted in accordance with ASME B31.3.

TANKSETT - In-service evaluations of tank flat bottom edge settlement, shell settlement, or bottom bulging are conducted in accordance with API 653 Annex B. This also includes an assessment of floating roof top stabilization and vapor escape.

Supplemental Design

The modules within the Supplemental Design package offer additional design capabilities beyond the base Design Code package.

AISCSSP - Determination of section properties for standard structural steel shapes as outlined in the AISC Manual of Steel Construction.

PWIND - Wind load determination is performed in accordance with ASCE 7, ASME STS-1 (for stacks), or the National Building Code of Canada (NBCC).

Materials

The Materials licensing package provides access to the industry's most comprehensive list of materials, physical, and strength properties with access to 250 combined years across 12 codes and standards.

MATDAT - Material property determination is based on Design Code material specifications, including those from piping codes like ASME B31.1, ASME B31.3, ASME B31.4, and ASME B31.8; vessel codes such as ASME VIII-1, ASME VIII-2, and ASME I; and tank codes including API 650, API 620, and API 653. Physical properties are also determined using WRC 503, while supplemental properties for FFS evaluations are provided by API 579-1/ASME FFS-1.

CHARPYH - Estimation of Charpy lower shelf, upper shelf, and temperature transition characteristics is performed using a hyperbolic tangent function data fit. Charpy test results can be based on either full-size or sub-size specimens.

Specialty FFS

The modules included within the Specialty FFS package allow users to conduct Level 3 FFS assessments, including advanced fracture analysis, on in-service or new equipment.

Crack-like Flaws

CLFLAW - FFS assessments of static, crack-like flaws are conducted in accordance with API 579-1/ASME FFS-1 Part 9 Level 2 for all components and load definitions. This includes utilizing all fracture toughness estimation methods outlined in Annex 9F. A customizable failure assessment diagram based on the material stress-strain curve is optional. The assessment also incorporates Part 3 Level 3 brittle fracture screening as specified in Annex 9J and provides probabilistic risk assessments for conditions involving low-temperature or high-pressure operation.

CLFLAWCG - FFS crack growth assessments for all Level 2 components and load definitions are conducted in accordance with API 579-1/ASME FFS-1 Part 9 Level 3. Options include evaluating time- or cycle-dependent crack growth, defining quasi-variable amplitude loads, and performing probabilistic risk assessments to estimate the remaining life of the components.

CLFLAWTA - FFS crack tearing evaluations for Level 2 components and load definitions are performed in accordance with API 579-1/ASME FFS-1 Part 9 Level 3.

Creep Damage

CREEPALLOW - FFS creep damage evaluation is conducted in accordance with API 579-1/ASME FFS-1 Part 10. This evaluation includes determining future time, temperature, or stress limits based on one or more past operating conditions, as well as generating Level 1 screening curves for assessment.

TUBELIFE - FFS remaining life assessment for fired heater tubes is performed using a coupled heat transfer and stress analysis approach, incorporating material properties from the MPC Project Omega. This evaluation follows the guidelines set forth in API 579-1/ASME FFS-1 Part 10.

Fatigue

FATLIFE - In-service, new design, or FFS evaluations of components subject to cyclic loading are conducted in accordance with ASME VIII-2 Part 5 or API 579-1/ASME FFS-1. This includes using ASME Smooth Bar or Structural Stress methods and defining quasi-variable amplitude loads.

Probabilistic Risk Assessment

FITDISTS - Fitting probability distribution functions to a series of input data points includes options for various distributions, such as normal, log-normal, exponential, Gumbel, Frechet, Weibull, Beta, Rayleigh, rectangular, and triangular. Random distribution sampling can be performed for normal, log-normal, and Weibull distributions. Probability plot fitting is available for normal, log-normal, and Weibull distributions.

Detailed Stress Analysis

The Detailed Stress Analysis licensing package includes tools to help you conduct stress analysis for shells, nozzles, pipes, and elbows. The results of these analyses can be used within an FFS assessment to improve structural reliability of in-service equipment.

General Shells

FAST1 - Stress analysis of branched shells of revolution subject to axisymmetric loading conditions including pressure and temperature. The shell thickness and load may vary along the shell meridian.

FAST4 - Stress analysis of branched shells of revolution subject to axisymmetric and non-axisymmetric loading conditions including pressure and temperature. The shell thickness and load may vary along the shell meridian.

ASMEHP - Stress classification with acceptance criteria for one or more components in accordance with ASME VIII-2 Part 5.2.2. This includes ratcheting evaluation using the Bree diagram, as well as fatigue evaluation based on ASME Smooth Bar or Structural Stress methods.

Bends and Elbows

ELBOW - Stress analysis of pipe bends or elbows is conducted in accordance with WRC 179. The analysis also includes FFS assessments in accordance with API 579-1/ASME FFS-1, such as brittle fracture screening per Part 3, general metal loss assessment per Part 4, and the evaluation of crack-like flaws in accordance with Part 9. Additionally, creep screening is performed as specified in Part 10, and fatigue analysis follows Part 14 of API 579-1/ASME FFS-1.

Nozzles and Attachments

FAST2 - Stress analysis of nozzles in cylindrical or spherical shells is conducted in accordance with WRC 297 and ASME VIII-2 Part 5 for stress classification. This involves evaluating primary pressure and weight loads, as well as secondary thermal loads. The analysis also includes FFS assessments in accordance with API 579-1/ASME FFS-1, such as brittle fracture screening per Part 3, general metal loss assessment per Part 4, and the evaluation of crack-like flaws in accordance with Part 9. Additionally, creep screening is performed as specified in Part 10, and fatigue analysis follows Part 14 of API 579-1/ASME FFS-1.

BIJLAARD - Stress analysis of cylindrical or spherical shells with circular or rectangular attachment locations is conducted in accordance with WRC 537 and WRC 107, drawing on the work of P.P. Bijlaard.

WRCLUGS - Stress analysis of lug attachments on cylindrical pressure vessels or pipe sections is performed in accordance with ASME B31W or WRC 198.

Fluids & Heat Transfer

The Fluids & Heat Transfer licensing package can be used to determine how to safely conduct welding repairs or modifications of in-service equipment by considering process, temperature, heat transfer, and fluid properties.

HotTap Simulation

HOTTAP - Hot tap evaluations for split sleeves, branch connections, or weld-o-lets are conducted to assess potential burn-through or heat-affected zone cracking in accordance with the Equity Software model.

HOTTAPTA - Hot tap evaluations for split sleeves or branch connections are performed to assess potential burn-through or heat-affected zone cracking in accordance with the original Battelle model.

Heat Transfer

TANAL - Steady-state heat transfer evaluations for a layered cylinder, sphere, or flat plate involve internal film calculations based on the fluid mixture and flow rate, or user-defined parameters. External film calculations are based on ASTM C680 or user-defined methods.

TSDANAL - Transient heat transfer with coupled hydrogen diffusion and stress evaluation for a layered cylinder, sphere, or flat plate includes internal film calculation based on the fluid mixture and flow rate, or as defined by the user. External film calculation is performed according to ASTM C680 or based on user specifications. The analysis also incorporates integral mass and energy balances of the process fluid.

TRACING - Steam tracing is designed to maintain a desired minimum process temperature within a piping system or for a small-diameter vessel made from pipe material.

Fluid Properties

MIXER - Thermodynamic and transport properties of multi-component fluid mixtures are estimated using a database of over 1,800 pure component properties. The primary estimation method is the Peng-Robinson equation of state (EOS). The system includes supplemental mixing rules, such as van der Waals or Wong-Sandler, to determine the EOS coefficients for the mixture. Property estimation can be performed for various conditions, including bubble point, dew point, isothermal flash, isentropic flash, or isenthalpic flash.

PNENERGY - Piping system volume and stored energy estimation for a pneumatic test involves calculating the total volume of the piping system and the energy stored in the compressed air within it. This assessment helps ensure safety and compliance with testing protocols.

IntelliJoint*

INTELLIJOINT - Bolt-up load and gasket optimization to prevent joint leakage, gasket damage, or excessive flange and bolt yielding are evaluated in accordance with ASME PCC-1, WRC 510, and WRC 538. This includes simultaneously comparing multiple gasket types and geometries, optimizing to minimize the risk of leakage or component damage, and providing a bolting assembly procedure. Additionally, a supplemental turn-of-nut evaluation is available for in-service tightening.

**IntelliJoint must be licensed separately from PlantManager SAGE. Please contact Client Success for more information.*

PlantManager ASSET

PlantManager SAGE subscribers may extend subscriptions to include PlantManager ASSET®. This software is a cloud-native planning and inspection lifecycle operations technology that provides end-to-end asset lifecycle management capabilities by managing inspection activities, recording damage management locations (DMLs), and calculating fully quantitative API 581 risk assessments for inspection optimization.

What is an AIMS?

An inspection data management system (IDMS) is the most common software program in use at many facilities to help collect, organize, store, and analyze data related to inspection activities. However, not all IDMS are alike or provide a complete set of features and functionality. PlantManager ASSET is a full-functioning asset integrity management system (AIMS) that includes all IDMS capabilities plus the comprehensive features and best practices to ensure the safety, reliability, and optimal performance of pressurized equipment. An AIMS will support jurisdictional compliance, prevent equipment failures, and mitigate risks to ensure the continuous and safe operation of equipment in a facility.

Benefits

I *Unified Platform*

Integrates document management, inspection and maintenance planning, and damage mechanism assessments in one system to improve efficiency and reduce errors.

II *Ease of Use*

Features an intuitive interface for novice or expert users to easily navigate across the complete asset management system.

III *Proactive Risk Management*

Combines risk-based inspection (RBI) with integrated corrosion analysis to prioritize inspections and minimize failures.

HOW TO CHOOSE THE RIGHT AIMS FOR YOUR PLANT

PlantManager ASSET

Integrated:

Initiate FFS, RBI, and other integrity analyses directly from inspection results. ✓

Data & Document Management:

Catalog inspections, design and engineering documentation, and reliability data to easily access mechanical integrity documents and asset records. ✓

Reporting & Activity Management:

Monitor and analyze inspection activities for timely equipment delivery and issue escalation. ✓

Customizable & Scalable:

Implement modular, cloud-native software tools that allow you to add or subtract functionality based upon need. ✓

Cloud-native:

Achieve faster calculations using superior performance hardware and always have access to the latest software updates. ✓

Secure:

Use software that is certified to ISO 9001:2015 quality standard and SOC2 Type 2 compliance. ✓

CONTACT US for a demo

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TURN INPUTS INTO INSIGHTS

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