Summary of Changes in New Revision of AS4324.-2017

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Abstract

This article provides a high level summary table of updates in the AS4324.1-2017 standard and likely implications for new and existing machines.

The high level changes in the AS4324.1-2017 revision are:

- Technical specification becomes part of the standard and can vary some requirements
- Electrical/mechanical protection settings assumed in the structural design loads must be documented and checked/tested
- Need to check requirements for high strength (>450 MPa) and imported materials if they are proposed.
- Duplication of suspension ropes is required
- Higher abnormal digging load for reclaimers
- Failed luff cylinder load case is required
- There are some differences in cyclone wind loads and limit state load combination factors that will have an effect on the structural design depending on whether permissible stress or ultimate limit state design basis is used.

High Level Summary of AS4324.1-2017 Compared to AS4324.1-1995		
Item	**Change in 2017 revision compared to 1995 revision**	**Comment / Likely Impacts**
Scope and Application	The code committee worked on basis that the revision was an update of the existing standard to: • Clarify the interpretation of clauses that had been found to be ambiguous • Allow for changes to the way that machines are procured since 1995 • Allow for updates to associated design standards such as AS4100 steel structures. As such, the overall structure of the standard, and the load clause numbering was kept the same as the previous revision.	The most comprehensive summary is Appendix A - Explanatory Notes in the 2017 revision, which details the changes to each clause.
Technical specification	There is a requirement for a technical specification. The standard has minimum requirements but also allows the purchaser to nominate some of the input design assumptions e.g. load calculation variables. If load cases are omitted in the specification, there should be a formal risk assessment process to justify it.	This is a new requirement, but major companies always have technical specifications.

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Application	The standard applies to equipment designed after the publication of the standard. The standard should be used for risk assessment of machines built before publication (continued use, modification, upgrades). The approach is to help assist with statutory safety in design requirements.	New machines should comply with the standard. Old machines should be checked to the standard and risk assessed.
Corrosion allowance	There is a possible need to include a corrosion allowance for some parts of the structure. The machine needs to be inspected through its life.	This would be as per the technical specification requirements.
Load Limiting Devices (Electrical and Mechanical)	The code committee intends to develop mechanical, electrical and asset management parts 2, 3 and 4 respectively. There is guidance on industry standards until these parts are developed. There is a requirement to document and check that structural load design assumptions such as overload settings, clutch settings, brake settings, hydraulic settings, collision load parameters are documented (calcs and manuals). It should then be checked that the assumed settings are actually implemented in the control system design and during commissioning of the mechanical equipment.	The structural load assumption overload settings should be documented. The settings should be checked in the control system and commissioned brake, clutch and hydraulic settings. It should be possible to test the settings. The requirement for these checks was not stated as explicitly in the previous revision.

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Materials	Materials must generally be compliant to AS4100 and subordinate standards which is unchanged. There are some changes for high strength materials with Fy > 450MPa (e.g. Bisalloy). These materials are now allowed with conditions but were previously not permitted. If high strength materials are proposed, then extra quality assurance work will be required. There are some new requirements for imported steel made to overseas standards.	If high strength materials are proposed, then extra quality assurance work will be required. If imported steel is used, there are additional material substitution requirements.
Structural Design Loads	The loading causes have minimum requirements, and allow some flexibility to vary some loads in the technical specification.	The changes in the design loads will have some effects on the structural design compared to the previous revision. These differences would need to be determined by using the 1995 load combination table and the 2017 load combination table in the structural model to compare the results. Calibration studies estimate this is about +/- 5% compared to previous revisions for a few machine models that were checked.
Product Bulk Density	Different densities are allowed for live load, power, encrustation, volume etc. This is consistent with industry practice.	It has been normal to vary these items in technical specifications.
Permanent Dynamic Effects Load (DD)	The general load factors table is unchanged. There is a new calculation technique allowed for overturning stability based on the actual acceleration multiplied by 1.2 dynamic factor.	This is generally favourable for stability compared to the previous ambiguity of how to apply the load factors.

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Abnormal Digging Resistance Load (UU)	There are some updates to the cause generally. There is a requirement to calculate the load based on at least 200% FLT up from 150% FLT if there is no effective torque limiting coupling.	The minimum digging design load for reclaimers is likely to increase.
Abnormal Lateral Digging Resistance Load (SS)	There is a new note that the clutch should be on the output side of the brake.	Some machines have the brake on the output of the clutch.
Non-Permanent Dynamic Effects Load (DD)	There is a new note to consider personnel safety on walkways e.g. that the brake deceleration does not cause people to be thrown off walkways.	There has been a trend to have high brake holding wind speeds in specifications which means that brake capacities are high. This can cause high e-stop decelerations that could potentially be unsafe.
Travel Device Obstructed Load (LL)	300mm collision distance can be varied by the specification. Long travel cow-catcher kill switches are recommended. Machines with wide rail gauges will need skew control defined in the specification. Tripper legs can be designed for seized wheels dragging on the rail or as per specification.	It has been normal to vary these items in technical specifications.
Lateral Boom Collision (FS) and End-on Collision (FT) Loads	The clauses are basically the same but with more detail on the interpretation of the requirements.	It has been normal to vary these items in technical specifications.

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Wind While Idle Loads (WWp and WWu)	The standard describes two alternative methods for applying the AS1170.2 wind speeds with AS4324.1. The designer can use permissible stress design or ultimate limit state design methods. The permissible stress method is consistent with the previous revision. The permissible wind speed conversion factors, and the AS4324.1 ultimate limit state load combination factors mean that ultimate limit state design method is more onerous than permissible stress design for the cyclone wind load combination.	The ultimate limit state wind loads are more onerous than the permissible stress wind loads for cyclones overall. There might be different structural designs depending on whether permissible stress or ultimate limit state design methods are used.
Bucketwheel Loss Load (BL)	There is more discussion and provision for partial loss of the gearbox only and not the full bucketwheel assembly. This is in line with industry practice.	It has been normal to vary these items in technical specifications.
Load Combination Tables	There are now two load combination tables. One table for permissible stress design and one table for ultimate limit state design. Some of the ultimate limit state load factors have been updated based on reliability analyses.	There was calibration work done comparing the results using the old and new load combination tables. The structural sizing is expected to be similar or within +/- 5% in general.
Overturning Stability	The specification should define if the factor of safety against overturning for cyclone wind loads should be 1.2 or 1.5. This is related to the difference between WWp and WWu.	There might be different results depending on whether permissible stress or ultimate limit state design methods are used.
Resistance Against Drifting Ratios	There is a new requirement to check the driving power against the operating and relocating wind speeds to ensure that drives are adequately sized. The drive sizes determine certain structural design loads.	The drive sizes should be checked before the structural design loads are finalised.
Structural Design	Duplication of the structural design requirements has been removed where requirements are covered in AS4100.	This removes ambiguity in the design process.

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Fatigue Life	There is a minimum design life of 100,000 hours.	This is the same as most specifications.
Plate buckling	There are references to overseas standards that cover plate buckling which is not well covered in AS4100.	This removes ambiguity in the design process.
Fatigue Design	Eurocode 3 and IIW standards are allowed in addition to AS4100. This is to be defined in the specification. These standards have more detailed information compared to AS4100. They also provide more guidance on FEA methods.	This removes ambiguity in the design process.
Wire Rope, Stays and Hydraulic Cylinders Factors of Safety	There are some updates to the requirements for wire ropes, stays and hydraulic cylinders. There is a new clause that requires wire ropes to the duplicated as a pair. The safety factor requirements are similar but have been simplified. Chains and racks are included in the scope of the clause. Hydraulic cylinder failure must be considered as a load case. The load combinations included must be in the specification.	Failure of hydraulic cylinders is covered in specifications. There is now also a minimum requirement in the standard. Suspension ropes need to be twin ropes not single ropes.

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Mass and Centre of Gravity Weighing of Machine	There is more detail in the standard requiring the mass and CoG to be tracked during design. In the old revision, the requirement was that the as-built mass was within 5% of the design. In the new revision, it is more specific that the balance i.e. CoG position, luff cylinder forces and wheel loads must also meet the 5% criteria, not just the total weight.	This is the same but the weighing process, analysis and record keeping needs to be more thorough.
Ancillary Structures, Rail Loads	Detail added for how to apply loads to ground structures like buffer frames, rails and cyclone restraints.	This removes ambiguity in the design process.
Major Maintenance Loads	Detail added about major maintenance design loads.	This removes ambiguity in the design process.
Appendices	There are updates to Appendices A to L based on the changes outlined above.	