Counting faults

Australia's CraneSafe assessment programme has produced a detailed database of faults, across all crane types and makes. Stuart Anderson analyses the data and identifies the main areas of concern for crane owners.

Since 2002, Australia's CraneSafe programme has established itself as probably the most comprehensive and successful voluntary scheme of its kind anywhere in the world. Last year alone, over 4,000 mobile cranes were subjected by their owners to independent assessment and certification in a scheme that yielded reports identifying over 21,000 individual crane faults.

As CraneSafe's crane service history database expands it is generating one of the most comprehensive crane fleet performance analyses ever developed, with the potential to shine new light on repetitive crane service and performance issues. During its seven years of operation, over 5,500 different cranes have been assessed and approved, but there's still a long way to go before all of the country's estimated population of upwards of 10,000 working cranes have been assessed to verify their compliance with Australian Standards. Some cranes have now been assessed each of the past seven years. The total number of CraneSafe's 'Green Stickers' (approvals) now issued exceeds 15,000.

CraneSafe's initial mission was to meet the requirements of a third party independent annual inspection of cranes, to ensure that they met the applicable mandatory Australian crane regulations, and health and safety standards. As CraneSafe has grown in customer acceptance and operational professionalism, the scheme has developed a whole range of valuable information and services to crane owners and users, as well as to product and service suppliers. These include auditing service providers, crane replacement assessments and road worthiness checks.

The scheme was heavily motivated by the recognition of the potential safety and regulatory compliance problems posed by the floods of second-hand cranes imported from South East Asia and elsewhere during the 1990s. In one especially notorious shipment, some 26 very old cranes were imported from New Zealand.

The scheme was launched in Victoria. In 2003, the states of New South Wales and Western Australia adopted the scheme and other states soon followed. Last year, the Queensland Crane Association added its full support, completing the nationwide coverage. More than a thousand cranes were assessed in Queensland, the first time this many cranes have been assessed in a single state.

Overall, 2008 saw a 25% increase in the number of cranes assessed (Table 1), and even though a record number of some 750 new mobile cranes were sold, there was also strong growth in the number of older existing cranes submitted for assessment. Older cranes are the least likely to be submitted to CraneSafe assessment but, of last year's 4,000-plus cranes assessed, while 65% were relatively 'young' cranes of up to 10-years-old, 32% were between 10- and 25-years-old and a fraction over 3% were older than 25 years (Table 2). CraneSafe added tower cranes, overhead bridge cranes and telescopic handlers to the scheme in 2008. The scheme now extends to 15 different varieties of cranes and lifting machinery.

At its launch, CraneSafe gave a 'bye' to all new cranes. Upon the tendering of a PDI (pre-delivery inspection) report, all new cranes were automatically given CraneSafe's Green Sticker, signifying the

Table 1: Crane assessment type summary (2006-2008)

	2006	2007	2008
All terrain	421	558	649
Hydraulic truck	573	671	705
Articulated frame	756	1153	1,516
Rough terrain	392	513	601
Lattice crawler	135	198	239
Hydraulic crawler	154	202	277
Lattice truck	24	18	17
Luffing tower	-	-	2
Self-erecting tower	-	-	3
Hammerhead tower	-	-	3
Rigid telehandler	-	-	2
Truck loader	-	-	55
TOTAL	**2455**	**3316**	**4069**

Table 2: Crane assessment age and type summary (2008)

	Units	Average	0-5yrs	5-10yrs	10-25yrs	25yrs+	Oldest
All terrain	649	5.41yrs	363	182	102	2	27yrs
Hydraulic truck	705	12.36yrs	200	70	387	48	38yrs
Articulated frame	1,516	5.17yrs	940	296	269	11	34yrs
Rough terrain	601	11.35yrs	143	101	326	31	45yrs
Lattice crawler	239	10.56yrs	98	40	75	26	43yrs
Hydraulic crawler	277	8.76yrs	96	50	128	3	34yrs
Lattice truck	17	33.82yrs	0	0	3	14	42yrs
Telehandler	2	3yrs	2	0	0	0	3yrs
TOTAL:	**4069**	**8.08yrs**	**1877**	**752**	**1295**	**136**	**45yrs**

Table 3: Crane assessment age summary (2006-2008)

AGE:	2006	2007	2008
Less than 5yrs	802	1290	1877
5-10yrs	656	792	752
10-25yrs	909	1120	1304
25yrs+	88	114	136
TOTAL	2,455	3,316	4,069
Average age:	9.63yrs	8.76yrs	8.08yrs
Total 10yrs & older	1137	1421	1615
Oldest Crane:	48yrs	44yrs	45yrs

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Table 4: Total number of faults by crane type (2008)

	AT	Hydraulic truck	Artic chassis	RT	Lattice crawler	Tele crawler	Lattice truck	Truck loader	Hammer-head	Self-erector	Tele-handler	Total
Cranes	649	705	1,516	601	239	277	17	55	3	3	2	4,069
Faults	2,338	6,539	6,094	4,101	1,038	537	455	45	2	2	2	21,151
Ratio	3.6:1	9.27:1	4.02:1	6.82:1	4.34:1	1.94:1	26.76:1	0.82:1	0.66:1	0.66:1	01:01	5.19:1

Table 5: Summary of fault areas by crane type (2008)

TYPE:	AT	Hydraulic truck	Artic chassis	RT	Lattice crawler	Tele crawler	Lattice truck	Truck loader	Hammer-head	Self-erector	Tele-handler	Total
NUMBER OF CRANES:	649	705	1516	601	239	277	17	55	3	3	2	4,069
AVERAGE AGE	5.41yrs	12.36yrs	5.17yrs	11.35yrs	10.56yrs	8.76yrs	33.82yrs	-	-	-	3	8.08yrs
% OF FLEET	15.95%	17.34%	37.26%	14.77%	5.87%	6.81%	0.42%	1.35%	0.08%	0.08%	0.06%	100%
FAULTS:												
Boom & Attachment*	496	1,491	1,572	976	295	128	99	8	0	0	2	5,067
Revolving Frame & Cab**	438	1,440	1,348	1,072	357	221	104	17	0	0	0	4,997
Slew system	65	199	0	129	38	6	21	4	0	0	0	462
Winches	144	674	241	370	132	43	32	1	0	0	0	1,637
Hydraulic System	126	312	286	313	42	12	21	4	0	0	0	1,116
Air System	22	57	108	20	6	0	3	0	0	0	0	216
Chassis or Crawler	525	1,188	1,185	706	70	40	57	10	0	0	0	3,781
Electric System	222	394	797	339	48	48	58	0	0	0	0	1,906
Drive System	132	219	372	145	12	11	13	0	0	0	0	904
Carrier Cab	0	408	0	0	0	0	37	0	0	0	0	445
Function Tests	33	84	108	82	34	3	2	1	2	2	0	351
Crack Tests	35	73	77	47	4	25	8	0	0	0	0	269
TOTAL FAULTS	2,238	6,539	6,094	4,199	1,038	537	455	45	2	2	2	21,151

* Including A2B pendant/switch. ** Including SLI/LMI & A2B alarms

Table 6: Top ten specific faults (2008)

ITEM AT FAULT	OCCURRENCES
SLI or LMI	815
Wire rope: main	498
A2B @ head	480
Vehicle suspension	289
Boom angle indicator	264
A2B alarm	259
Back-up alarm	243
Level indicator	224
Wire rope: aux.	200
Vehicle brakes	157

crane's assumed regulatory compliance as well as its operational fitness. Experience showed this assumption of compliance was false, as CraneSafe discovered that new cranes supplied by even the world's leading manufacturers often did not meet Australian crane standards. At the beginning of last year, this exemption loophole was closed and all cranes must now be fully assessed in order to get their Green Sticker.

CraneSafe operates on a pretty lean budget, essentially under the day-to-day management of national CraneSafe co-ordinator Jeff Brundell (late of P&H/Terex Australia and Potain/Manitowoc) and John Gillespie, CICA president and managing director of Gillespie's Cranes. They are the CICA CraneSafe steering committee and, supporting them, CICA has just three full-time staff.

The team of assessors comprises 50 private contractors located across Australia that have been appointed and licensed by CraneSafe. These assessors must have certain proven skills and experience with cranes, and employ fully-documented CraneSafe procedures. Assessment reports and practices vary according to each type of crane. Typically a single crane assessment covers over 200 items ranging from the performance of test lifts, function tests, instrument and operator aid checks, crack tests, and complete compliance with the fine detail of compliance with applicable Australian Standards such as AS 1418 and AS 2550: Cranes—Safe Use. The role of the assessor is to identify any infractions in a report presented to the crane owner or user, whose responsibility it is to then correct any faults. The assessor is required to specify a maximum period within which the faults must be rectified, but this is expected to be within 30 days. The crane is then re-assessed and all faults rectified before the crane receives its Green Sticker signifyng that it has been "maintained and is safe to operate".

To date, in excess of 80 different brands of crane have been assessed. Franna is by far the leading brand with almost 2,000 cranes assessed, in turn making its parent Terex the largest supplier. Tadano comes next with almost 1,000 cranes assessed, followed by Kato with over 500, then Liebherr and Grove. Thanks again largely to Franna, locally-produced articulated frame cranes are the dominant variety with close to 2,150 cranes assessed, followed by hydraulic truck cranes, RTs, ATs and lattice crawlers (Table 1).

Analysis of the ages of cranes assessed offers interesting insights. Surprisingly, the oldest assessed crane is not a lattice, but a rough terrain: a 45-year-old Austin-Western 410 cab-down. Next is a 43-year-old Lima 700 lattice crawler, one of many Lima truck and crawler cranes still doing good work. Another venerable name, P&H, is well represented by the oldest lattice truck crane, a 42-year-old 155A-TC, and the oldest hydraulic truck crane, a 38-year-old T-300. The oldest articulated frame crane is a 34-year-old 1974-vintage domestically-produced BHB TC48C tractor crane. Predictably the oldest all terrain is 'only' 27 years old; again it's a P&H, a Dortmund-built S-20. Although the average age of Australia's assessed all terrains is a mere 5.41 years, the average age of the articulated cranes that have been assessed is just 5.17 years, confirming that large numbers of older cranes of this type have not yet been assessed. The recent strength of new crane sales to Australia is clearly the main factor driving down the average

age of cranes assessed from 9.63 years in 2006 to 8.08 years in 2008 (Table 3).

Without question, the most illuminating findings of this scheme are its quantitative and qualitative identification of crane service and performance issues, called 'faults' by CraneSafe. A total of 21,151 faults were identified by the CraneSafe assessors' inspection and testing of 4,069 cranes in 2008, an average of 5.19 faults per crane (Table 4).

In reviewing this analysis of faults according to crane type, it is important to recognise that this is a study of only those cranes that have been assessed and not the whole Australian mobile crane population. It is also vital to take into account the average age of these cranes. For example, it'll be noted that the ratio of number of faults to the total number of lattice boom truck cranes is extraordinarily high at 26.76 faults per crane. Lattice truck cranes accounted for just 2.15% of all assessed mobile crane faults; they represent only 0.42% of the assessed fleet by number. This is not only a reflection of the extreme average age of these cranes (33.8 years) but is also due to the fact that these are quite large cranes that have to travel on public roads, often with permits. Similarly, hydraulic telescopic boom truck cranes accounted for 30.92% of all faults while being only 17.34% of the fleet, again due in large part to the high average age of 12.36 years.

The relatively low incidence of faults with articulated boom cranes (4.02:1) is a reflection of the very low average age of the cranes assessed (5.17 years) rather than a true representation of the condition of the entire population of these cranes, since many older cranes of this type have not been assessed. The comparison between the average number of faults between, on the one hand, hydraulic truck cranes (9.27:1) and rough terrains (6.82:1), and all terrains on the other (3.6:1) is again all largely due to the respective ages of the cranes assessed rather than their relative susceptibility to problems. In terms of overall minimum number of faults, taking average age into account, the best performing types of cranes assessed were hydraulic telescopic boom (mini) crawler cranes and lattice boom crawler cranes.

Turning to the areas of the cranes that involved the most faults (Table 5): 24% were in the boom and attachment (including the anti-two-block pendant and switch) followed closely by the revolving upper and cab (including the safe load indicator or load moment indicator). Rubber-tyred carriers and crawler lowers combined accounted for almost 18% of total faults while winches and their wire ropes accounted for 7.74% versus just 2.2% for slew systems. However, since the articulated cranes do not feature slewing uppers, this number needs to be adjusted and is actually 3.06% for slewing cranes. It will be noted that some 269 crack tests were performed but in fact this is not necessarily an indication of 269 cranes with structural cracks. For example the State of Victoria Crane Association mandates that all operational cranes are crack tested annually and the number shown here includes those crack tests that coincided with the assessments.

The list of the top ten 'faults' (Table 6) continues to be dominated by issues with safe load indicators/load moment indicators with 815 issues and anti-two-block devices. In addition to a variety of issues with SLIs and LMIs, the assessors found 94 cases when during crane lifting tests the devices failed to properly warn of overloads. Just how many of these devices were simply old, broken systems remains to be evaluated, but clearly these remain major problem areas.

Above and beyond this list there are large numbers of issues in the general areas of wheels and tyres as well as in respect to Australian Standards' very exacting requirements for the proper labeling of items such as boom sections, hook blocks and other parts, with either their tare weights or rated capacities and the demand for English language warning and instruction decals, load charts, operators books, and other documentation. These demands are a response to the infractions perpetrated by grey market imports.

Issues with anti-two-block (A2B) devices occur in respect of the proper functioning of their alarms (259 issues) as well as some 480 recorded issues with the A2B equipment installed at the attachment head. Of these, 224 were in connection with devices installed at main boom heads, 132 were rooster/auxiliary boom head installations and 124 were on boom extensions or fly jibs. The number of issues with various level indicators and inclinometers is very troubling given the essential nature, simplicity and relatively low cost of these instruments.

The magnitude of the problems with wire ropes (almost 500 with the main hoist rope and some 200 with the auxiliary hoist) unfortunately comes as no great surprise. This is an area justifying further analysis. Spooling issues pervaded and the fact that 85 hoist drum rotation indicator issues were identified is clearly a contributory factor.

Turning to issues with the vehicles, clearly the magnitude of suspension issues at almost 300 can in part be attributed to the long distances and rough roads sometimes travelled in Australia. However, this also provides insight into the performance of the different varieties of wheel-mounted vehicles:

- The 705 hydraulic truck cranes assessed in 2008 had 71 issues with front and 36 issues with rear suspensions. In Australia all truck cranes require some form of spring suspension all round.
- The 1,516 articulated frame Franna-type cranes suffered 95 suspension issues.
- The 649 all terrains suffered 49 issues with their hydra-gas suspension systems.
- The 601 rough terrains had 32 suspension issues.
- And the 17 (old) lattice truck cranes had 3 issues each with both front and rear suspensions.

During inspection of the swing systems, no less than 32 base welding issues were discovered:

- 14 of these occurred on hydraulic truck cranes—a worrying 2% of the number of cranes assessed.
- Eight were on RTs—1.33% of the cranes tested.
- Five were on the 239 lattice crawler cranes tested—again over 2% of the total.
- Four were on Australia's 277 predominantly mini telescopic boom crawler cranes—almost 1.5%.
- And one was on an all terrain—a very low percentage of just 0.15%.

While any number of the 200-plus specification and performance issues assessed under the scheme have potentially serious implications, possibly amongst the most serious are those that come to light during the crane lifting and function tests. During lifting tests, over 70 cranes had issues when attempting to lift maximum load while 53 had problems lifting in the stability zone. Hoist pull tests and hoist brake tests each revealed 66 issues while, as mentioned earlier, crane overload warning systems failed to function properly in 94 instances.

Clearly CraneSafe has made enormous strides over its seven years of operation but the scheme's national coordinator Jeff Brundell is by no means complacent: "Seeing the universal acceptance from everyone in the industry is very gratifying; we now have a vastly better crane industry that has better quality equipment and really just a safer industry. However, we are still reaching out to the fringe dwellers that either don't know, or don't care, what their legal obligations are. The toughest nut to crack is the secondary tower crane market and the truck loader segment. The first tier tower crane operators are, in the main, responsible and adhere to the basic safety requirements. The second tier group however totally ignores the legal obligations and there are many accidents waiting to happen. Truck loader operators need extensive training and vehicle inspections: far too many are being injured or killed through failure to comply with both issues."