

## Probe on the Drill Pipe Standard Revisions

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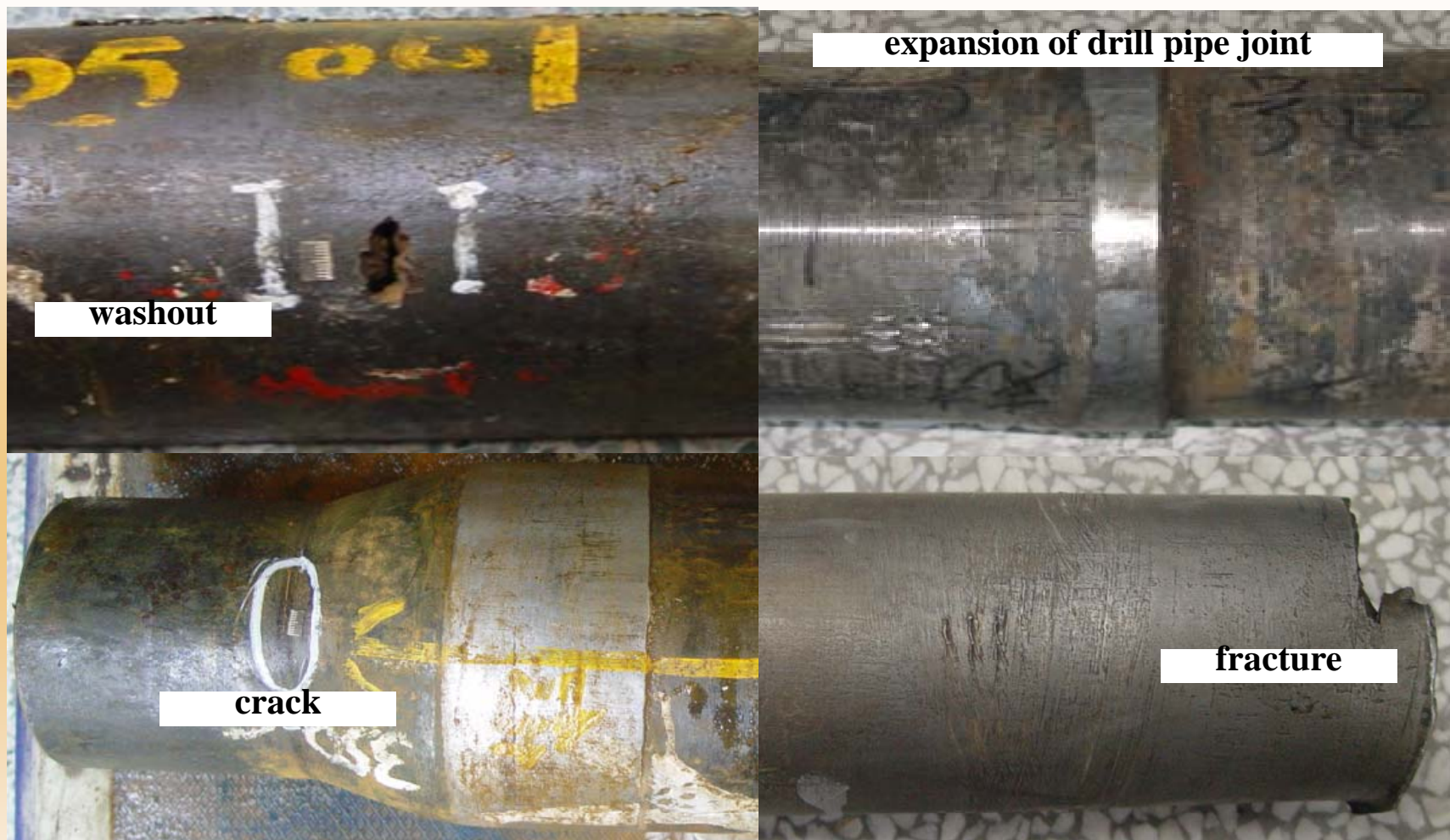
**Abstract: The paper fully investigates the current API standard and the Chinese standard on drill pipes. By contrasting the two standards, the author points out the importance of revising the domestic standard. The author suggests that efforts should be made to formulate, revise and publicize the domestic standard so as to enhance oilfields and manufacturers' awareness of standardization, improve the quality of drill pipe products and prevented accidents caused by drill pipe failures. Based on the failure analysis, experimental data, and research results from the “piercing before fracturing” theory in connection with the manufacturing status of drill pipe, some further revision is suggested for the current drill pipe standards in order to improve the longitudinal impact toughness value of the drill pipe body and joints from 54J to 80J, and to set the transversal impact toughness value of the joints at 60J under -20 °C as optional.**



## 1、Preface

- Drill pipe accounts for 80%~90% of the total drill stem length.
- Drill pipe failure occurs commonly in well drilling.
- It is of great significance to improve the quality of drill pipe and prevent drill pipe failures.
- It is effective to strengthen the revision of standards

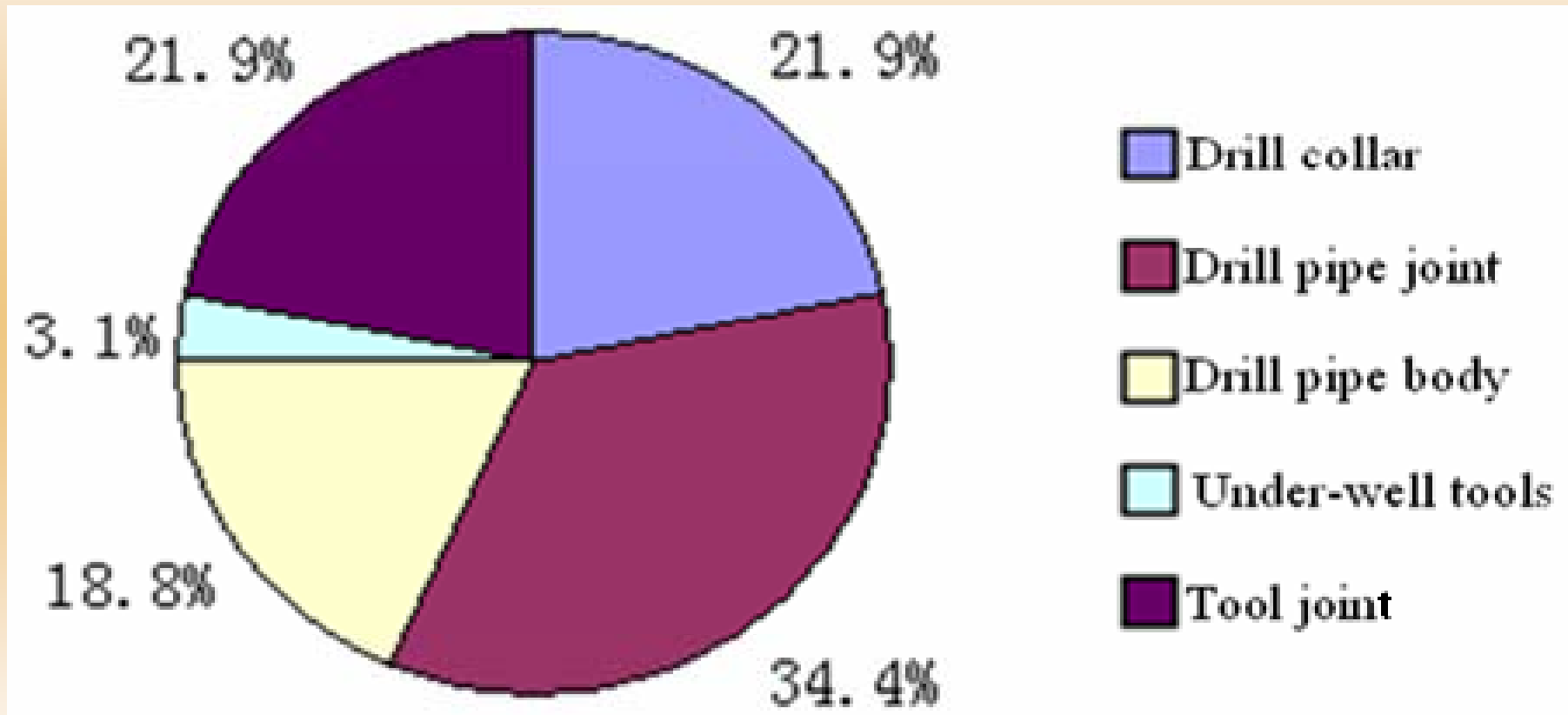




Typical drill pipe failures



Among a total of 32 failures with drill stems, 17 are drill pipe failures, accounting for 53.2%.



Failure analysis of a research institute in 2006



## 2、Current drill pipe standards in China and abroad

Two kinds of drill pipe standards in China.

### 1. American Petroleum Institute (API)

- API Spec 5D (Specification for Drill Pipe)
- API Spec 7 (Specification for Rotary Drill Stem Elements).

### 2. Chinese petroleum and natural gas industrial standards (SY/T)

- SY/T6697 Pipe body for drill pipe
- SY/T5290 Tool joints for drill pipe



## Related standards of drill pipe used in China

Standards No.	Standards title	Issued date	Standards No.	Standards title	Issued date
GB/T9253.1	Threads on rotary shouldered connections for petroleum industry	1999	SY/T5561	Friction Welded Drill pipe	2008
SY/T5824	Inspection and classification for drill pipe	2002	SY/T5987	Technical condition for ordering foreign drill pipe	1994
SY/T5290	Tool joints for drill pipe	2000	GB/T20659	Aluminium alloy drill pipe	2006
SY/T0544	Internal coating technical condition for drill pipe	2004	SY/T6407	specification for rotary drill stem elements	1999
SY/T6288	Practice for selection and use of drill pipe and drill collar	2007	SY/T6719	Applicability evaluation method for defect drill pipe	2008
SY/T5446	Ultrasonic inspection for drill pipe weld	2000	SY/T5198	Drilling tools thread compound	2003
SY/T5711	Brush copper plating and phosphating for drilling tools thread	1995	SY/T5448	Magnetic-particle-inspection for Drilling tools thread	2000
SY/T6697	Pipe body for drill pipe	2007			
API Spec 7-1	Specification for rotary drill stem elements	2006	API Spec 5D	Specification for drill pipe	2002



- **Product performance improving.**
- **Service conditions changed .**
- **New conditions to meet .**
- **Standard usually needs to be revised.**

**Table 2 Revisions of API standard**

<b>standard</b>	<b>Edition</b>	<b>Issued date</b>
<b>API Spec 5D</b>	<b>The third edition</b>	<b>1992</b>
	<b>The fourth edition</b>	<b>1999</b>
	<b>The fifth edition</b>	<b>2001</b>



### 3 Examples for drill pipe standard revisions

- Before API Spec 5D, Aug, 1999, only E75 Miu  $\geq 50.8$ mm, X95、G105 and S135, not required
- Many piercing failures occurred before 2000.
- The fourth edition of API Spec 5D, Aug, 1999, amended the Miu  $\geq 76.2$  mm
- As a result, the service life of these high grade drill pipe is doubled than before.



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Piercing surface of drill pipes



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- API Spec 7, 1986, the sealed shoulder amended, from 150.4 mm to 154.0 mm
- API Spec 7, 2001, 18° slopes drill pipe joint shoulder, as the purchaser requirement
- Decrease the number of drill pipe failures effectively.
- Adopted by the oil fields and manufacturers



Expansion of drill pipe joint



Piercing failure of drill pipe joint

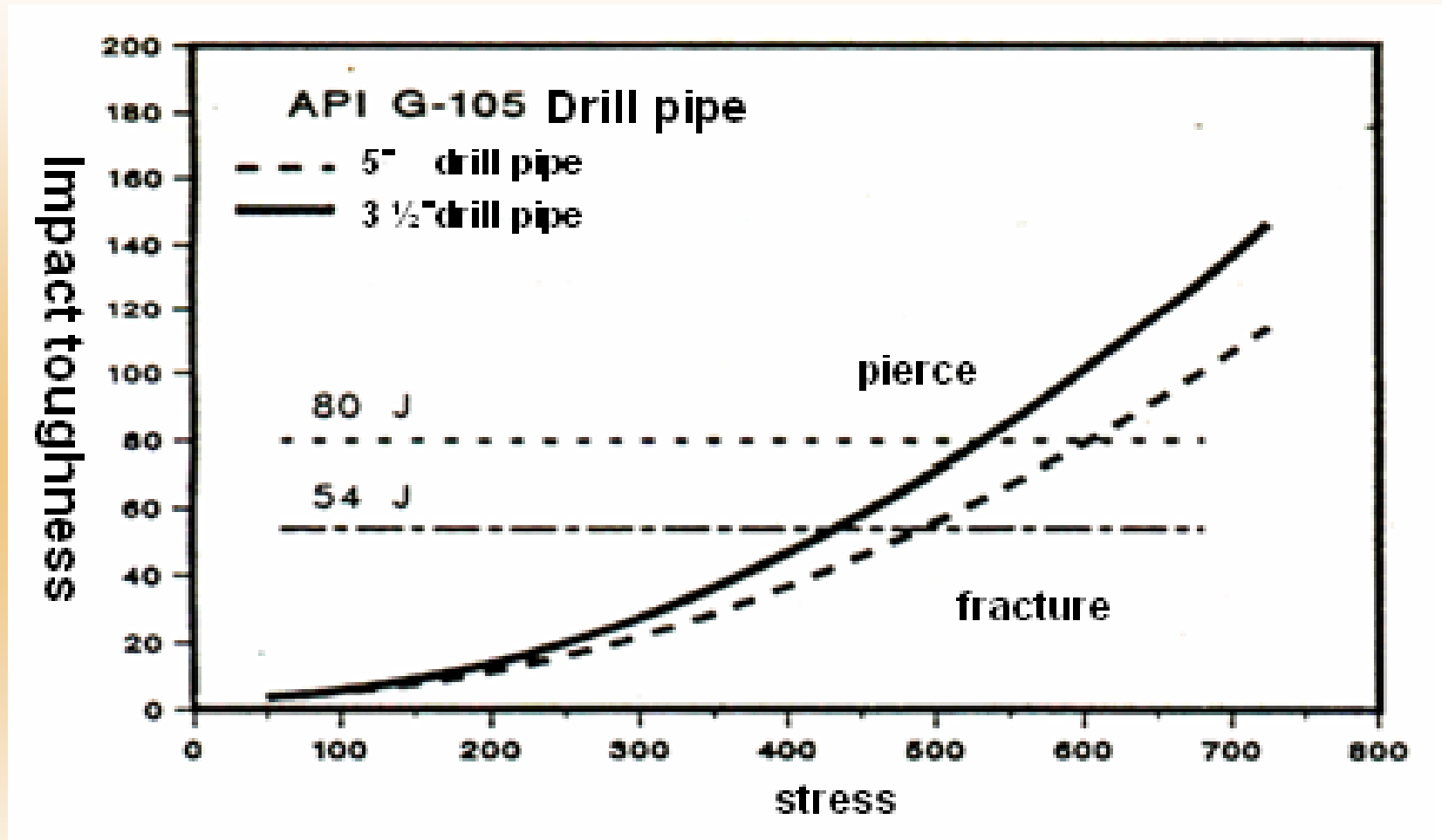


## 4 Suggestions on the amendments of the current drill standards

### 4.1 Impact toughness of drill pipe body

- API Spec 5D , 1992, impact energy value, 47J for single and 54J for average.
- Up to 2008, standards still un-revised
- Drill pipe quality has a great development and progress.
- Based on “piercing before fracturing” theory, minimum toughness is specified as less than 80J under 20°C.





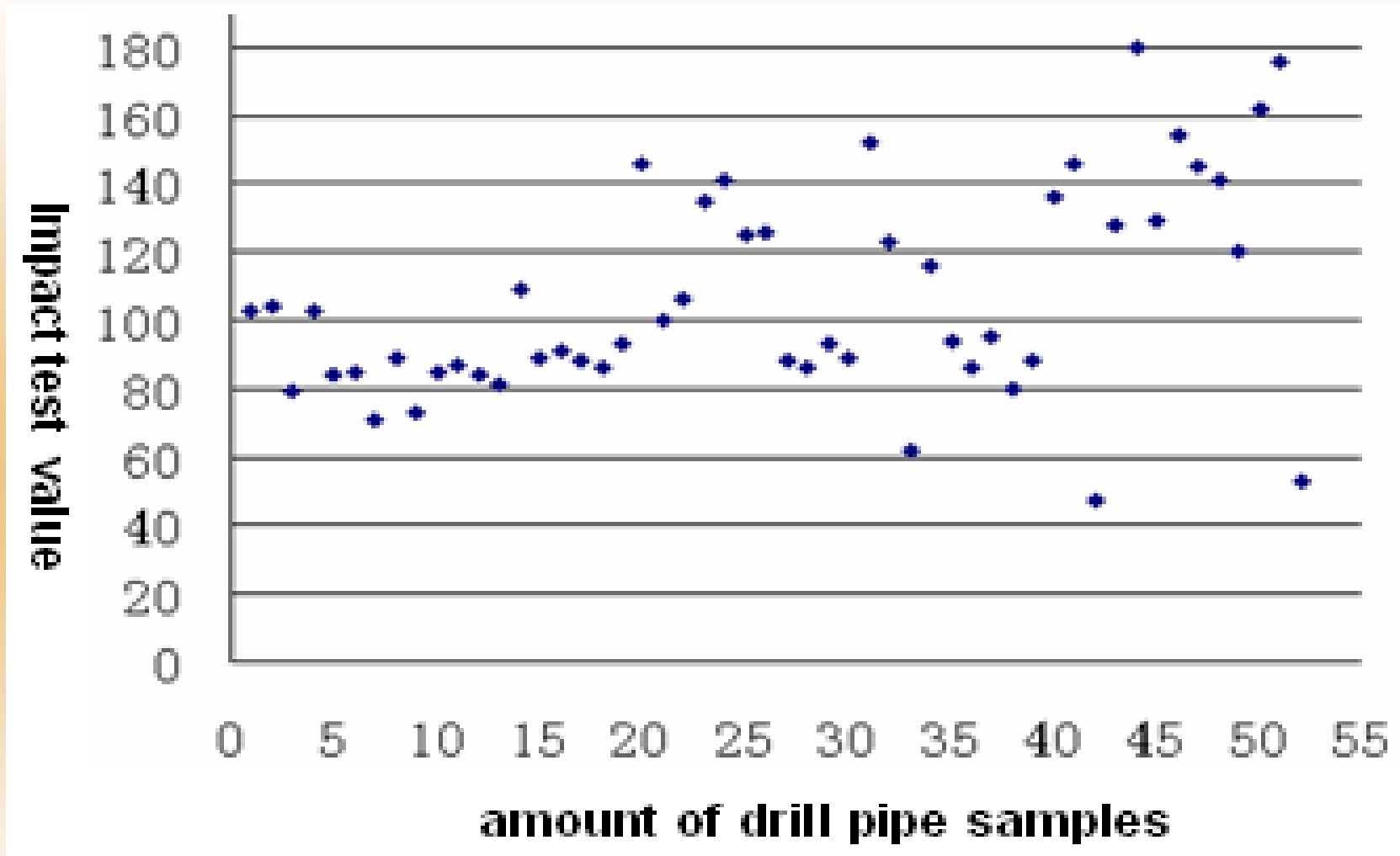
The relation between Impact toughness of drill pipe with piercing and fracture



- **52 failed drill pipe, the pipe body impact tested under 20°C.**
- **Nearly 88% is higher than 80J, individual value up to 180 J.**
- **Only 6, lower than 80 J, accounting for 12%.**
- **These failed drill pipes came from almost all the oil fields and manufacturers in China, representing the present quality level of the drill pipes made and used in China.**
- **It is necessary to revise the drill pipe standards, from 54J to 80 J.**



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The longitudinal impact test value of drill pipe



## 4.2 Drill pipe joint impact toughness value

- API Spec 7, 2001 and SY/T5290, 2000, only longitudinal impact energy is required.
- Average 54 J and single 47J in -20 °C.
- Transversal impact energy is not required.
- In practice, it is not enough to require only the longitudinal impact toughness.
- Some longitudinal fracture failure occurred.





The uneven wearing and longitudinal fracture of drill pipe joint



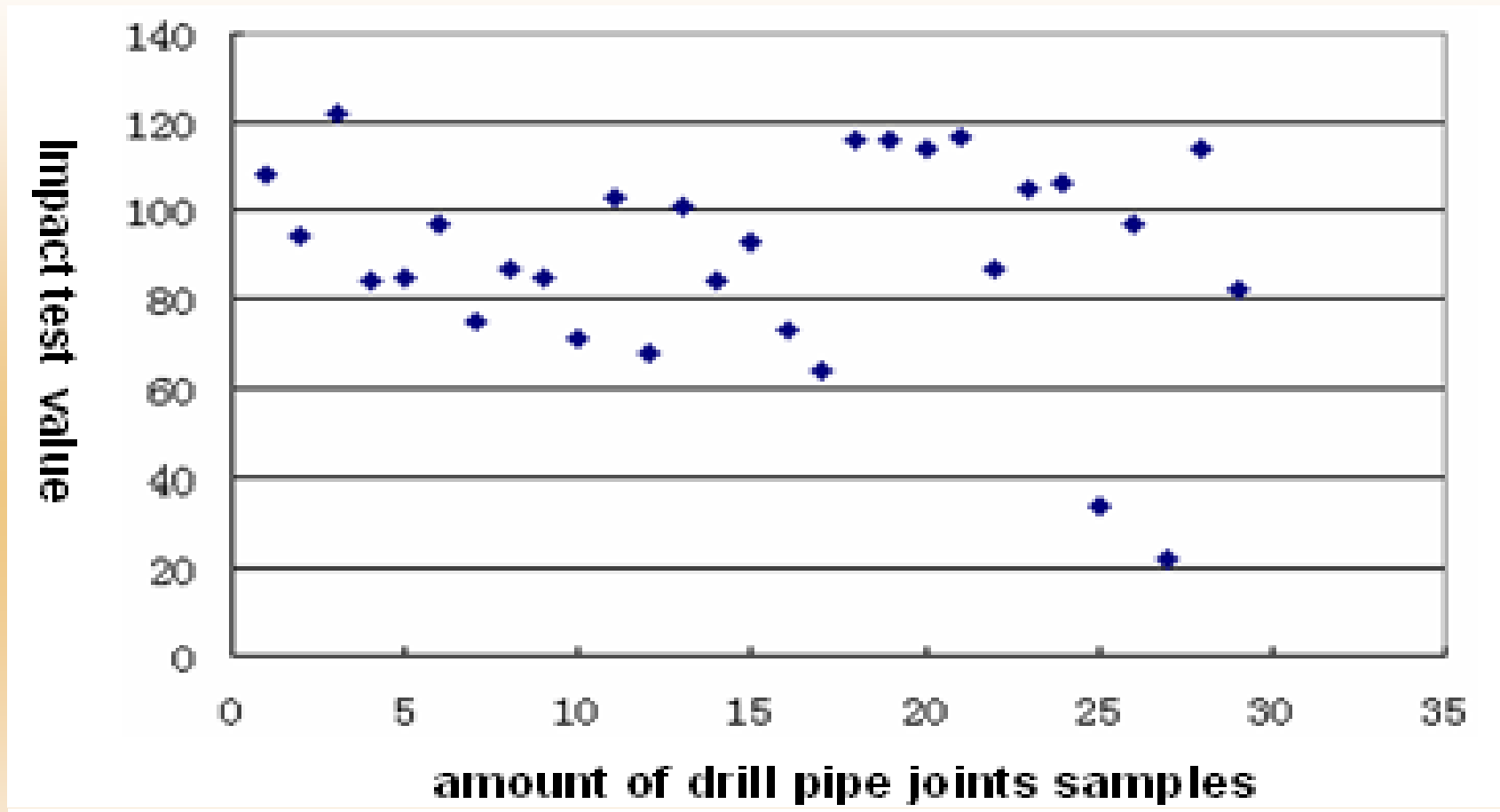


The microstructure of outer surface material  
of longitudinal fracture drill pipe joint



- **29 failed drill pipe joints are tested, longitudinal -20°C.**
- **2 joints, the value is 22J and 34J. The metallographic structure does not meet the standard requirement.**
- **The average value is 94J.**
- **22 joints, higher than 80J, accounting for 81%.**
- **Only 5 joints, lower than 80J, accounting for 19%.**



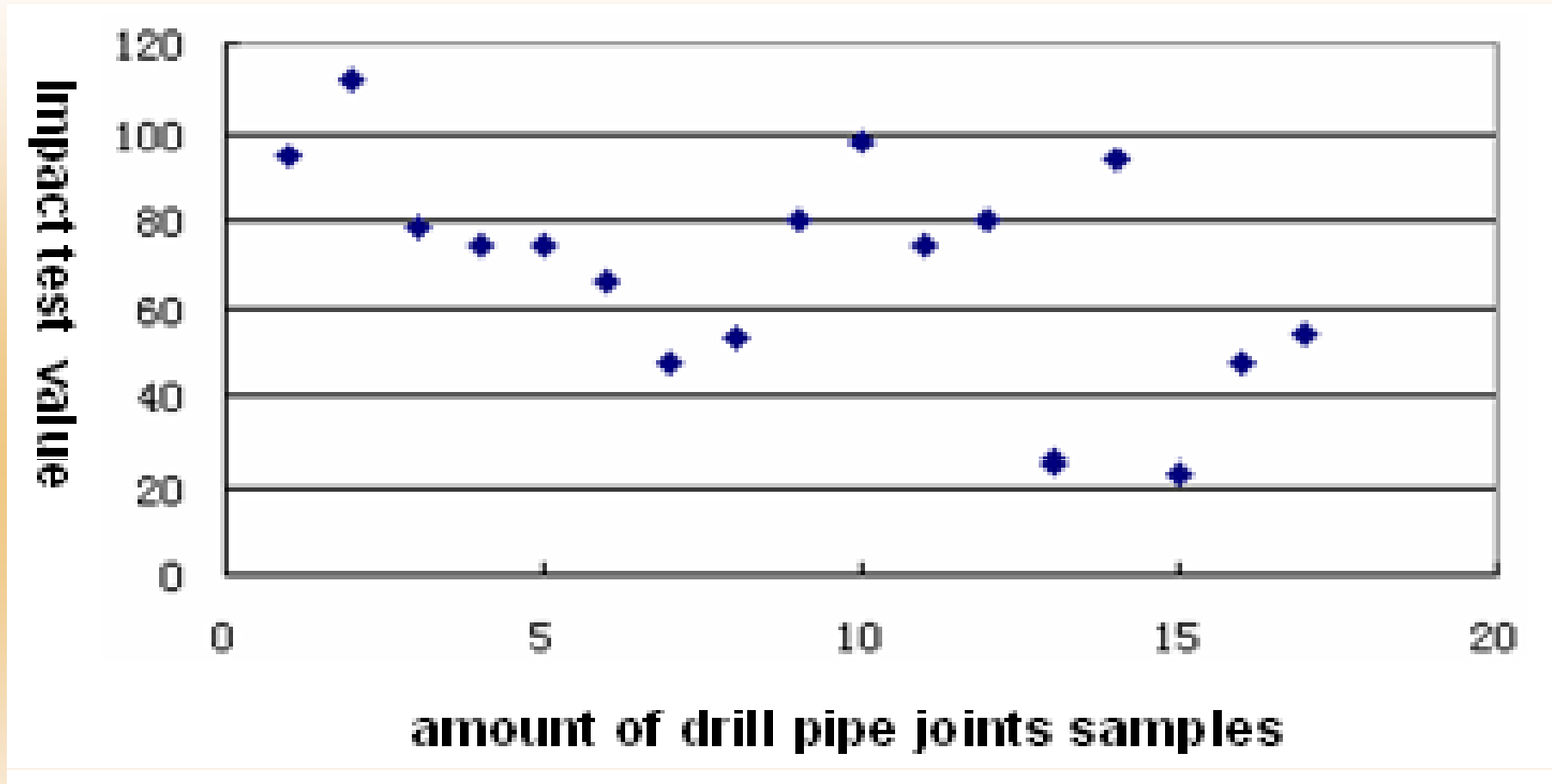


The longitudinal impact test value of drill pipe joints



- **17 of 29 failed joints are impact tested, transversal -20°C.**
- **2 joints, the value is 23J and 25J. The metallographic structure does not meet the standard requirement.**
- **The average value is 75J.**
- **11 joints, no less than 60J, accounting for 73%.**
- **Only 4 joints, lower than 60J, accounting for 27%.**





The transversal impact test value of drill pipe joints



- **It is helpful to raise the longitudinal impact toughness for the joint thread to resist the crack initiation and propagation, and to lengthen the service life of drill pipe joint.**
- **From the test data, 81% joints, toughness higher than 80J.**
- **The samples were taken by random from the oil fields and manufacturers, which can represent the quality level of current drill pipe joints in China.**
- **It is suggested to revise the longitudinal impact value from 54J to 80J.**



- **Research on the joint friction fracture failure mechanism is done.**
- **The research result is that the transversal impact value under 20 °C is no less than 78J, and it can prevent longitudinal crack failures effectively .**
- **3 longitudinal crack failures of joints are tested and the transversal impact values are 66J, 43J and 49J respectively.**
- **More than 73% of the joints have the transversal impact value higher than 60J under -20 °C.**
- **It is suggested to add the transversal impact value no less than 60J under -20 °C as the optional technical clause in the standard.**



## 5. conclusion

- It is very important to strengthen the revision and perfection of drill pipe standards so as to improve the performance and prevent failures of the drill pipe.
- Based on the failure analysis and experimental data in connection with the current performance of drill pipe, it is suggested to further revise the current drill pipe standards, which is to improve the material longitudinal impact toughness value of the drill pipe body and joint from 54J to 80J, and set the transversal full-size V-notch Charpy impact value of the joints at 60J under -20 °C as the optional technical clauses.



# Thanks!

