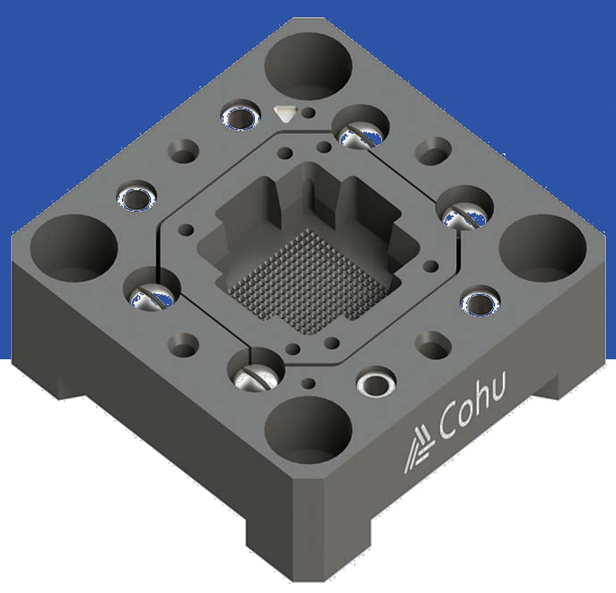
POSTER #

SWTest Conference

Cohu

Hydra – Simplifying and Standardizing Semiconductor Test

Rob Stoner
Cohu



Introduction

In this presentation we'll review the challenges faced, the DOE (Design of Experiments) and Monte Carlo methodology applied to analyze and develop the probe architecture and identify input / output variables such as barrel diameter, plunger shape, barrel gap and plating thickness that resulted in improved probe life, cRes optimization and achieving a common test height probe family with components that were truly interchangeable within each pitch and socket housing.

Desired Outcome:	
Increased performance (cRes, cycle count)	Reduce standard lead time
Standardization for customer use	Lower average cost

Achieve Outcome By:		
Latest design standards	Common pitch	Common test height
Standard options for DUT probe metal and platings	Standard options for DUT probe shape	

Methods

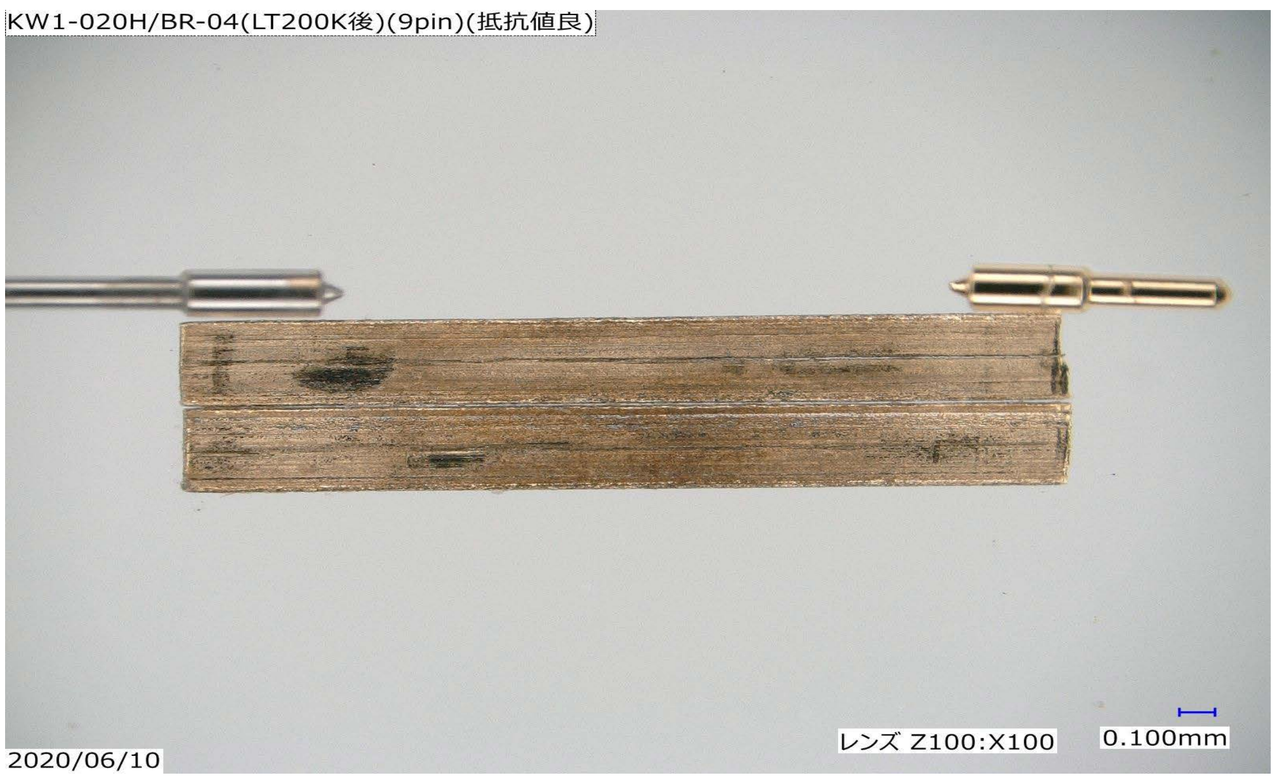
Defining the Best Probe Standard

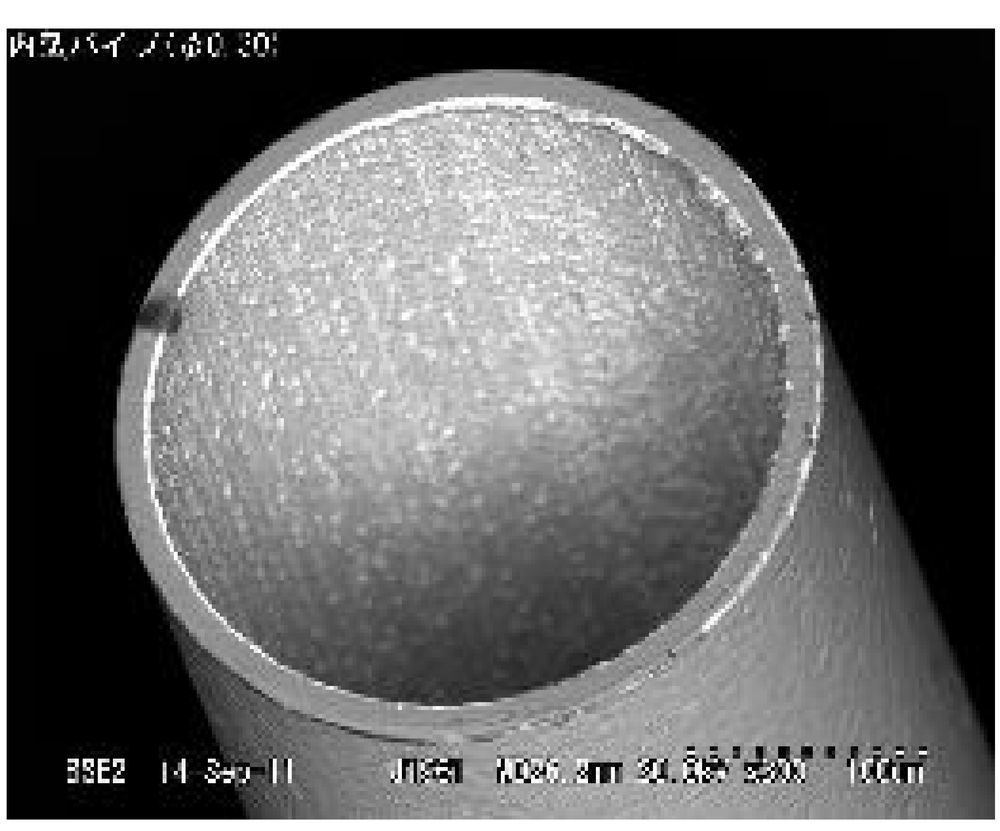
Analysis and improvement process:

1. Analyze poor performing probes for root cause
2. Perform Design of Experiments (DoE) to identify the correct value of design variables
3. Perform Monte Carlo analysis to confirm design tolerance
4. Improve existing probe to validate the design "recipe"
5. Carry this perfected recipe into new family of standard probes

Methods

Identifying Root Cause: Probes were dissected to determine failing features and cause





Inspection of failed probes

DoE's Performed to Test Hypothesis

> Barrel geometries > Spring geometries > Plating materials > Contactor cross sections > Plunger geometries

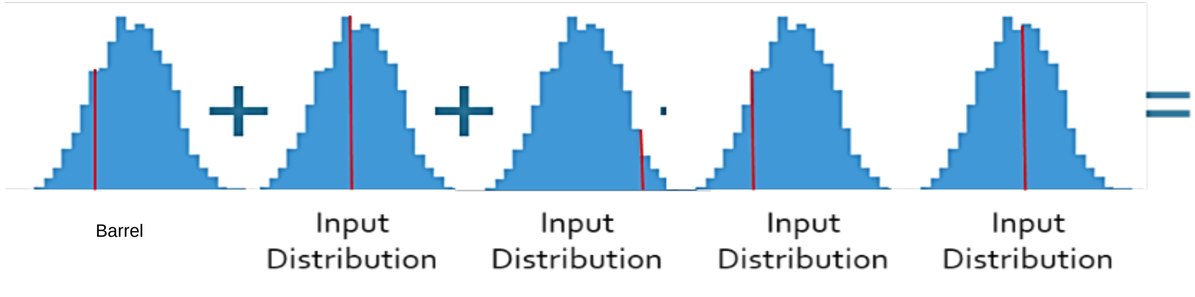
Proposed Improvements
- DoE's
- Field Data

→ Design/Build/Test Improved Probe → Confirmation of Probe Standard

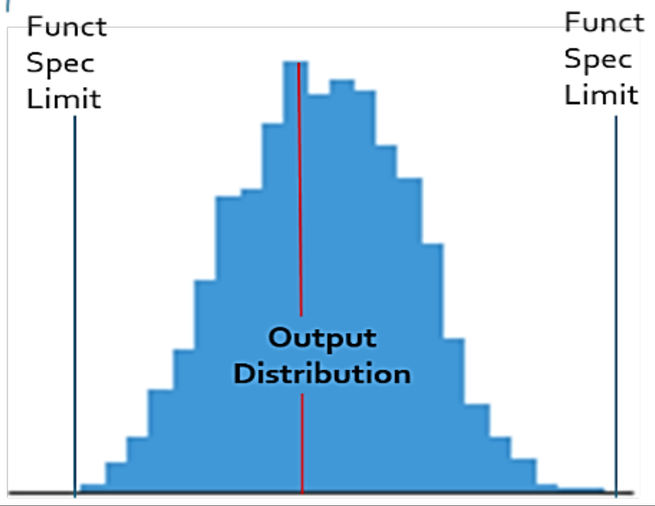
DOE	Process	Run	Positions	spring	DUT plunger Lot Number	Cycle Count	Outputs	cRes - average - discrete	cRes - std dev - discrete	cRes - Min - discrete	cRes - Max - discrete	cRes - average - cumulative	cRes - std dev - cumulative	cRes - Min - cumulative	cRes - Max - cumulative
Test 19	B	2	17 to 32	Lot 1	Lot 1	500000	Test 19	90.3	90.3	31	283	48.8	46.8	28	383

Design Verification: Monte Carlo Process and Analysis

Each input is simulated using a distribution reflecting reality



One instance of each input is randomly selected and run through the defining equation
- Run 10k times, creating an output distribution



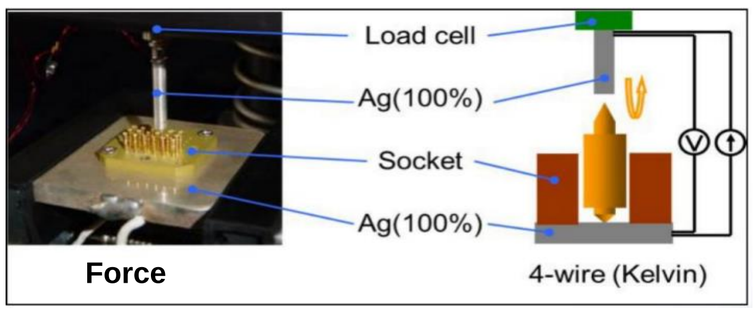
Output Metrics
- Cpk
- Defect PPM

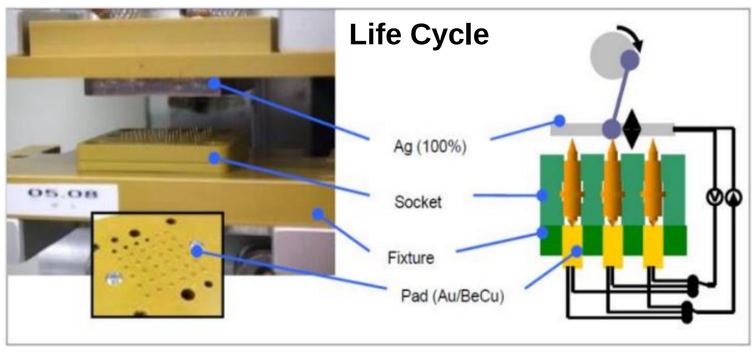
→ Cpk
→ Defect PPM

Results

Probes tested using correlated, validated test systems

- > Initial prototype batch tested
- > First production run also tested
- > Resistance and stability
- > Life Cycle up to 1,000,000 cycles
- > Probe Force through compression
- > Continuous Current Carrying Capacity (CCC)
- > Radio Frequency (RF)



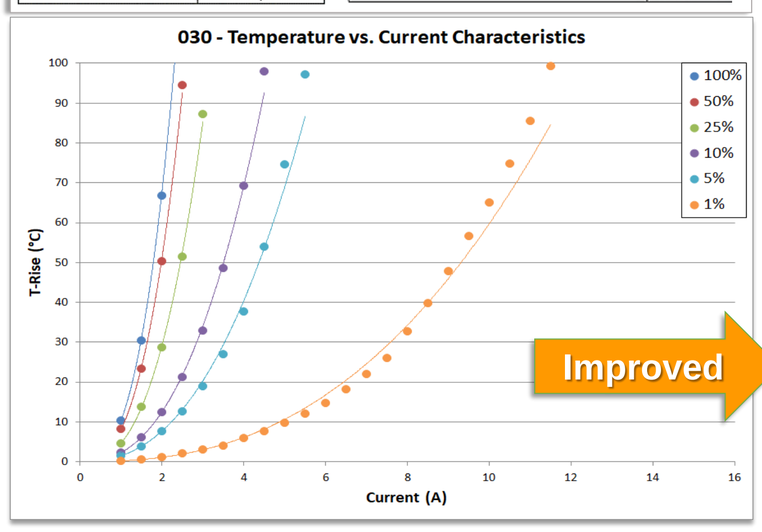


DC Specifications

20°C T-Rise Current:	1.3 Amps
40°C T-Rise Current:	1.6 Amps
60°C T-Rise Current:	1.9 Amps

Pulsed Current Specification

1% duty cycle, 20°C T-Rise Current:	6.4 Amps

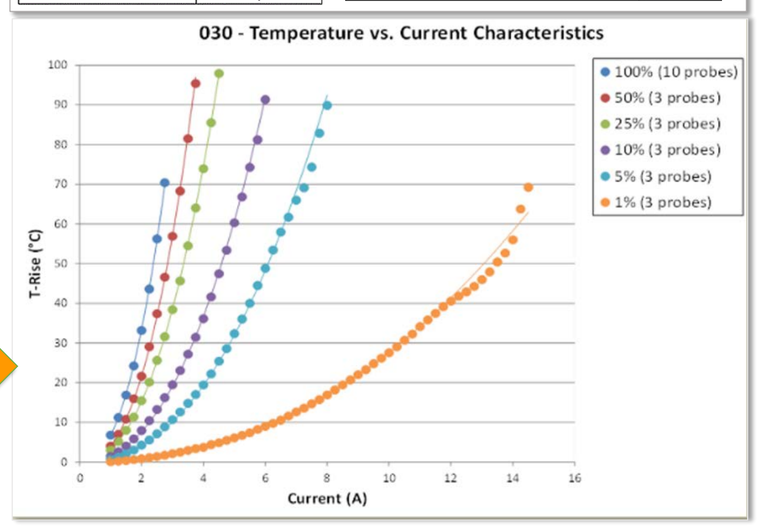


DC Specifications

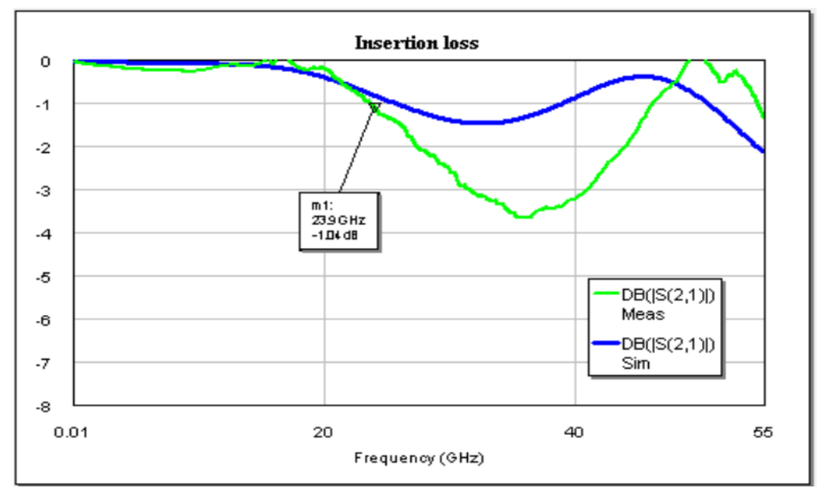
20°C T-Rise Current:	1.6 Amps
40°C T-Rise Current:	2.2 Amps
60°C T-Rise Current:	2.6 Amps

Pulsed Current Specification

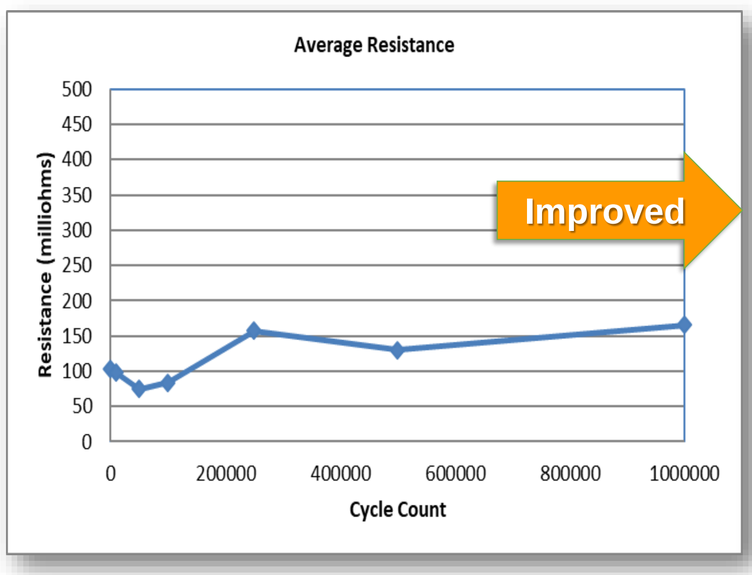
1% duty cycle, 20°C T-Rise Current:	8.6 Amps



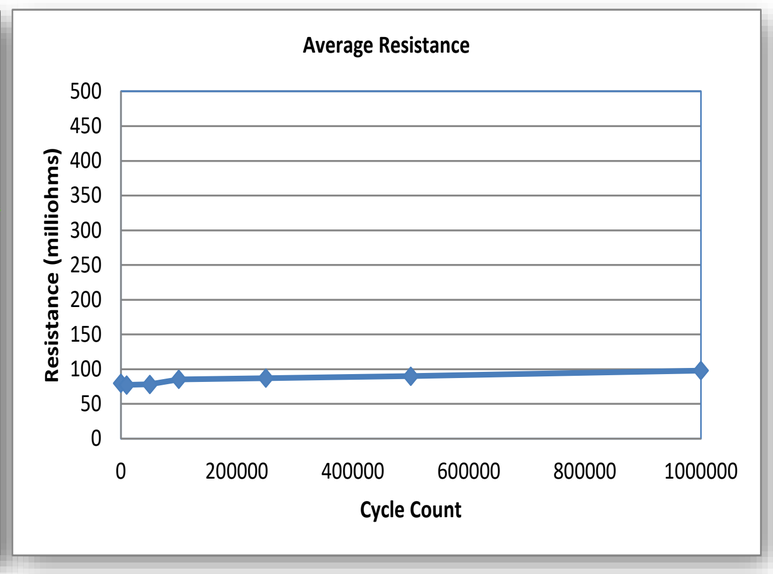
Improved

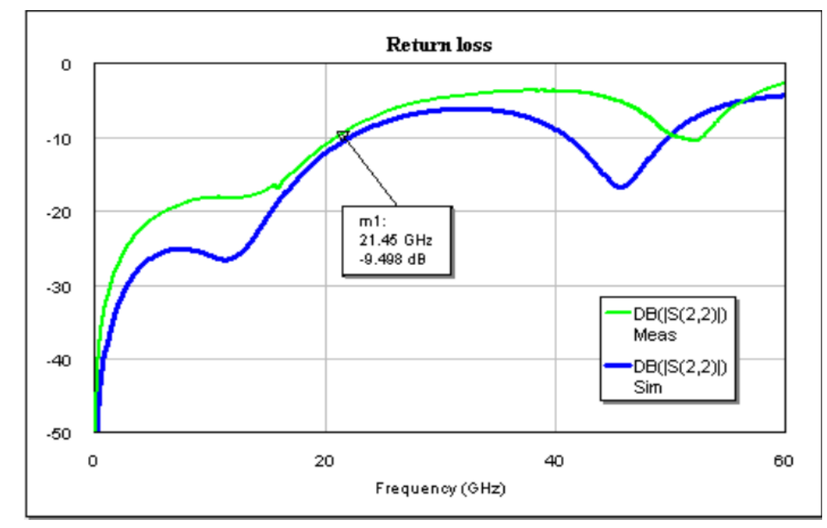


BANDWIDTH	FREQUENCY
GSG INSERTION LOSS (-1 dB)	**24 GHz**
GSG RETURN LOSS (-10 dB)	**21 GHz**



Improved





Conclusion

Outcome: Probe Tip Styles and Plating

Portfolio: 3 Test heights, 4 plating options, 3 tip styles, true probe interchangeability

Conclusion:

Performance Probe family optimized for best-in-class performance

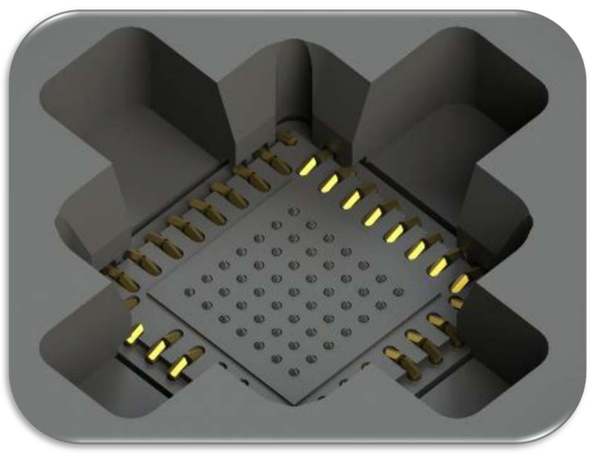
Standardization Ability to standardize tester/handler change kits and hardware

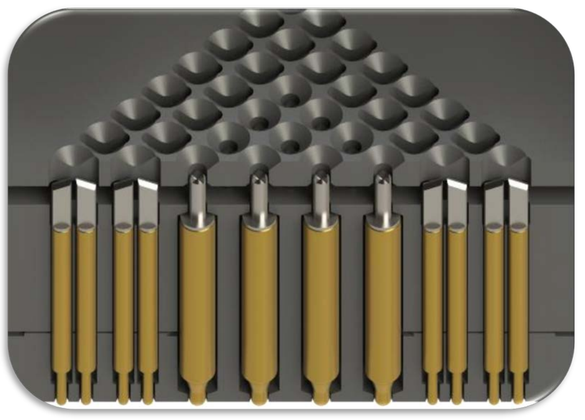
Interchangeability Mix-and-match power, RF and Kelvin in same socket housing

Efficiency Reduced part management and customer spares inventory

Reduced cost and lead time

Hydra Probes	Standard / Kelvin									
	Tip Style	Kelvin		Point				4-Pt Crown			
Test Height	Metal	Pd Alloy	2-2H	Pd Alloy	2-2H	Gold	N01	Pd Alloy	2-2H	Gold	N01
3.22 mm	HYD 015										
	HYD 030										
	HYK 030										
	HYK 035										
	HYK 040										
	HYD 040										
	HYD 050										
	HYD 080										
5.05 mm	HYD 015										
	HYD 030										
	HYK 030										
	HYK 035										
	HYK 040										
	HYD 040										
	HYD 050										
	HYD 080										
2.30 mm	HYD 015										
	HYD 030										
	HYD 040										
	HYD 050										
	HYD 080										





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