Wind Technician Tool:
Guidance and User Manual

UNIVERSITY OF HULL | CENTRE FOR HUMAN FACTORS

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Introduction

The Wind Technician Tool was developed through a collaboration between G+, SafetyOn, the University of Hull and the Health and Safety Executive (HSE).

The aim of the tool is to provide a validated survey, bespoke to the wind sector, that enables wind sector organisations to assess the risk of work-related stress amongst their staff generally, but also gather more detailed data about the stress risks specifically associated with working in the field as a repair and maintenance technician. It can provide quantitative data to evidence the prevalence and patterns of stress risks and this evidence can be used to develop targeted workplace interventions.

The Wind Technician Tool is available in two formats: a free-to-use pdf version and a paid for electronic version. This document has been prepared to: support those choosing the free-to-use version and outlines the sections of the Wind Technician Tool (WTT); provide guidance on collecting and managing data; and provide technical detail on the development methodology.

The Wind Technician Tool would be enhanced if it drew on a larger data set: therefore, you are invited to share your anonymised data with the University of Hull to enable further statistical tests.

We would like to thank G+, SafetyOn and HSE for funding the development of the Wind Technician Tool, with project support throughout from Beate Hilderbrand, Energy Institute. The project has also received essential engagement and support from a wide range of wind companies, for the benefit of the whole wind industry: we are grateful to Deutsche Windtechnik, EDF, SSE, Enercon, Nordex, Orsted, RES, Scottish Power, SGRE and Vattenfall. Finally, we would like to acknowledge the contribution of the participants - the project would not have been possible without their generous engagement.

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The Wind Technician Tool: Questions

The Wind Technician Tool can be administered by somebody with a good level of understanding and experience of using survey platforms, including set up and analysis involving filter questions, creating subscales and reverse coding. Administrators should also be competent at reporting survey results.

The tool has three sections:

A) Demographics completed by all staff
B) the HSE Stress Indicator Tool (SIT), completed by all staff; and
C) the wind technician question set completed by wind technicians in addition to sections A and B.

Section A: Demographics

The purpose of collecting demographic data is to enable comparisons to be made of the data for different groups such as grade, location, job role or work patterns. An analysis plan would help to identify what comparisons would be of interest and determine the appropriate demographics. Only demographics that are of value for specific purposes should be included for ethical reasons. To help protect anonymity, any demographic group should include 10 or more staff.

Suggested demographics for the survey are presented in Appendix 2: the suggested questions are based on the standard SIT demographics, but can be amended to meet the needs of your organisation.

Section A also includes two filter questions, one question to determine whether Section C should be presented (only for field staff) and a second question to determine whether the onshore or offshore variants of seven questions in Section C should be presented.

Section B. Stress Indicator Tool *

Section B is the HSE's Stress Indicator Tool (SIT). These questions represent seven important domains of stress risk, each represented by items arranged into the following subscales – Demands, Control, Peer Support, Management Support, Relationships, Role, and Change. The SIT addresses general stress risks that are potentially present in all working environments.

All staff, irrespective of role or working pattern, could be invited to complete the SIT questions.

Brief scoring guidance is included in the 'Analysing the Wind Technician Tool' section below. Full guidance for using this tool and interpreting the data is available from the Health and Safety Executive website at https://www.hse.gov.uk/stress/standards/downloads.htm.

Section C. Wind Technician question set

Section C is the question set specific to assessing the work-related stress risks of wind technicians or those who undertake elements of a wind technician's role as part of their job. The questions reflect on their working patterns, working conditions, and working relationships.

Considerations for data collection

Administration

The tool is presented here as a ready-to-use paper survey. To operationalise the survey on your own digital platform, load all the items into the platform ensuring each item has the correct response category options. It is vital that you include the filter questions in Section A, to determine the inclusion of Section C and the onshore/offshore question variants. With Sections B & C, do not change or remove any items, as this will undermine the technical properties of the subscales, and it will be difficult to know if you have reliable information. It is also vital to ensure the scores aligned with each response are consistent with the guidance. Following the guidance below will support an accurate interpretation of your findings.

Ethics

Ethical collection of this type of data requires clarity for the respondents in relation to what will happen to their data, i.e. how their data will be processed and used. It is also important that survey respondents are provided with a clear commitment in relation to data storage and security, particularly who will have access to the data, right to withdraw their data and the approach to confidentiality and anonymity. It is crucial that participants know that there will be no negative consequence for them if they complete this survey or do not complete the survey, and the protection of anonymity is therefore paramount to achieving a good response rate and collecting meaningful data. Further advice on collecting psychological data ethically is provided by the British Psychological Society: https://www.bps.org.uk/news-and-policy/bps-code-ethics-and-conduct

Health outcomes data

The items in Sections B and C refer specifically to stress risk. Obtaining data in this area will support your understanding of the prevalence and patterns of stress risks within your organisation. However, it is worthy of note that assessing psychological health outcomes alongside this stress risk assessment would offer the opportunity to explore current levels of health and wellbeing. Furthermore, when collected together, stress risk data and psychological health outcome data can be statistically analysed to examine predictive relationships between stress risks and psychological health outcomes, i.e. whether specific risks are predictive of anxiety and/or depression. This information may be particularly useful in prioritising interventions for areas where risks are most closely related to negative health outcomes. Many brief psychometric scales are available, for example, the PHQ-4 is a brief four item scale for mental health screening: https://qxmd.com/calculate/calculator_476/ patient-health-questionnaire-4-phq-4. This and similar tools could also be manually integrated into your paper survey or your own online survey.

The Wind Technician Tool: data analysis

The survey platform you use to administer the WTT may be capable of doing basic statistical analysis, or you may choose to transfer the data to Excel or a statistics package such as SPSS. It is essential that respondents' anonymity is maintained throughout data handling and analysis.

Section A. Demographics

Using your data analysis package, frequency data should be calculated to provide insight into the characteristics of respondents. Responses to these questions can also be used to compare groups and identify any between-group differences in mean scores. This can be achieved by filtering the data according to the demographic characteristics.

Section B. Stress Indicator Tool

Items 1-35 can be reduced to subscale means by averaging the scores for the sets of items detailed in Table 1. This data reduction process will provide seven subscale scores of stress risk.

Note that items for the Demands and Relationships subscales are negatively loaded (e.g. "My workload feels more intense when working remotely"). These scores are reversed in the scoring of the tool, so that high scores for all items and subscales consistently reflect positive work characteristics and a low stress risk.

Mean scores for individual items are also useful in further exploring specific areas of risk.

It is important to note that subscale scores should be compared to benchmarking data, rather than other subscales. Benchmarking data are available as means and as percentile scores. Benchmarking information for this instrument is available from the following academic paper by Webster and Edwards (2012) Work & Stress, 26:2, 130-142, doi.org/10.1080/02678373.2012.688554. This document provides normative scores for public and private sector companies and supports meaningful data interpretation.

Table 1. Management Standards SIT subscale reduction

Factor	Item Numbers
Demands	3, 6, 9, 12, 16, 18, 20, 22 (All reverse scored)
Control	2, 10, 15, 19, 25, 30
Peer support	7, 24, 27, 31
Manager support	8, 23, 29, 33, 35
Relationships	5, 14, 21, 34 (All reverse scored)
Role	1, 4, 11, 13, 17
Change	26, 28, 32

Section C. Wind Technician Tool

Items 36-79 are specific wind technician stress risk items that can be grouped as outlined below in Table 2. The WT domains directly relate to the seven stress risk domains of the SIT apart from (i) three additional WT factors: Fatigue Culture, Safety Culture and Wellbeing Culture, and (ii) Demands being split into WT Demands Intensity and WT Demands Environment (see Table 2 for subscale reduction key and Technical Information for psychometric justification of new tool structure).

To reduce the item scores into their subscale means, averages of the seven stress risk domains and three additional domains can be calculated, as directed below. There are four items with variations in terminology for onshore and offshore workers (see below) and three items that are for onshore technicians only.

Table 2. Wind Technician Stress Subscale Reduction

Factor	Item Numbers
WT Peer Support	36, 38, 46, 68, 76, 77
WT Management support	45, 50, 54
WT Control	41**, 55, 67**
WT Demands intensity	37, 39, 57, 69, 71*, 78 (All reverse scored)
WT Demands environment	59*, 66, 79 (All reverse scored)
WT Role	51, 56, 64
WT Change	43, 58, 61, 70, 74
WT Relationships	40*, 48, 49 (All reverse scored)
WT Fatigue culture	44, 47, 52, 72, 75**
WT Safety culture	53, 65 60*, 62 (Reverse scored)
WT Wellbeing culture	42, 63, 73

*Onshore and offshore variation in terminology
**Onshore only item

Technical Information

Background

The Wind Technician Tool has been developed in two phases.

Phase 1 involved a large-scale qualitative investigation of stress risks facing wind technician workers, including 27 in-depth interviews with technicians in onshore and offshore roles. Based on information from the interviews, 69 experimental items were written to represent job related stress risks identified through thematic analysis of the qualitative data. These items were designed to complement and extend the existing 35 items of the Management Standards. The data from this qualitative study were analysed into themes, described in the project report. (https://humanfactors.hull.ac.uk).

Phase 2 The 69 experimental items were piloted in organisation-level surveys of wind technicians in four companies operating in the sector. These surveys each included demographics, SIT and wind technician questions. Data were obtained from 365 total respondents, but with only 166 respondents working in field roles. Exploration of the psychometric properties of the scales using this data set resulted in the attached tool. Technical information to support the subscale structure, reliability and current validity evidence of the Wind Technician tool is presented here, along with initial percentile scores for benchmarking (based on the development sample of the four wind companies).

Further work: The development team would be very keen to further develop the tool, particularly to generate more evidence of validity from new organisations using the tool. If you are using the tool and would be willing to consider sharing your anonymised data, to contribute to future refinements, or you wish to consider some support in running the survey or data analysis, please contact Prof. Fiona Earle at the Centre for Human Factors, University of Hull. <humanfactors@hull.ac.uk>

Subscale structure and reliability

Step 1: Factor Analysis - The area of stress risk is complex and includes a series of distinct but related constructs, such as work demands and peer support. To develop a robust tool of stress risk, we need to explore the structure of the data using a process of factor analysis to see how the items in the survey relate to one another, statistically. To explore the most appropriate subscale structure, the wind technician data from the onshore and offshore field sample were subjected to Exploratory Factor Analysis (EFA) extracted with maximum likelihood approach, and with Oblique rotation (N=88). Items with factor loadings greater than 0.4 were retained. Items loading highly on two factors (>.4) were removed. This is a well-established factor analysis technique, used to explore complex data sets and provide a meaningful structure to organise items into subscales. This process revealed a strong structure, consistent with the existing framework provided by the Management Standards domains. Clear factors were identified for *WT Manager Support*, *WT Peer Support*, *WT Control*, *WT Demands* (with two distinct aspects of *Work Intensity* and *Work Environment*), *WT Change*, *WT Role* and *WT Relationships*. In addition to the MS-related factors above, three new stress risk factors were identified:

- ***Fatigue Culture*** – this is defined as the combination of policies, practices, attitudes and values in relation to fatigue risk management within the company - including shift patterns, travel time and perception of the company understanding of fatigue
- ***Safety Culture*** – this is defined as the combination of policies, practices, attitudes, values and perceptions about health and safety - including coherence of safety attitudes within the team and the emphasis of safety versus productivity
- ***Wellbeing Culture*** – this is defined as the combination of wellbeing policies, practices, attitudes and values in relation to wellbeing support – including wellbeing provision and access to wellbeing initiatives.

Step 2: Reliability Analysis - Following the process of factor analysis, the data were subjected to reliability analysis. This process ensures that a scale or subscale includes only closely related items that can be demonstrated to be part of a coherent set. For example, with the factor of 'peer support', it is important that all the items in this subscale represent meaningful aspects of peer support in a working context. Once we are confident that our subscale is reliable, then it is meaningful and justifiable to calculate subscale scores (e.g. a mean score of all of the items relating to peer support). Cronbach alpha statistics were calculated for the clusters or sets of items emerging from the Exploratory Factor Analysis (EFA). This provides a statistically sound basis for including or removing individual items from each subscale which are found to either contribute or detract from the subscale reliability. All items within each cluster were systematically reviewed for inclusion or removal, by considering their impact on the subscale reliability as well as their conceptual consistency. Scales with Cronbach alpha scores of 0.7 and higher are deemed to possess good reliability. The final subscale reliability analysis provided good support for the overall scale:

Table 3 Reliability Statistics of the WT Subscales

Subscale	Cronbach Alpha
WT Manager support	0.915
WT Peer support	0.841
WT Control	0.822
WT Demands – work environment	0.771
WT Demands – work intensity	0.871
WT Change	0.919
WT Role	0.740
WT Relationships	0.773
WT Fatigue culture	0.874
WT Safety culture	0.772
WT Wellbeing culture	0.980

Validity of the Wind Technician Tool subscales

Following psychometric support for subscale structure and reliability, the subscales required further statistical analysis to ensure the stress risk survey is valid and measures what is intended. Full validation will be dependent on further data as the tool is used in industry setting. However, initial validation can be undertaken with the development sample data. On the basis of the current data set, correlational analyses were undertaken to explore relationships between the WTT specific subscales and existing measures; these included the SIT tool and outcome measures such as mental health. The aim of these analyses was to examine the extent to which the tool subscales demonstrate an expected pattern of relationships with existing measures, i.e. stronger relationships with more closely related constructs (construct validity).

Construct Validity - WTT and SIT domain relationships

The strongest source of evidence for the WT domains comes from relationships with the related SIT domains. Ideally, these relationships should be moderate (e.g., r=0.4 - 0.7), as very strong correlations (e.g., above r=0.9) would question the added value of the WTT. Correlations between the WTT and SIT domains were all in the expected direction and all highly significantly correlated ($p<0.01$).

The WTT – SIT subscale correlations are summarised in Table 4 overleaf:

Table 4: WT – SIT subscale correlations

WT Subscale	SIT Subscale	Correlation Coefficient (r)
WT Manager support	Manager support	0.87**
WT Peer support	Peer support	0.78**
WT Control	Control	0.64**
WT Demands - work intensity	Demands	0.75**
WT Demands – work environ't	Demands	0.38**
WT Change	Change	0.84**
WT Role	Role	0.50**
WT Relationships	Relationships	0.66**

** correlation is statistically significant at the 0.01 level

All of the correlations were in the expected direction i.e. positive, supporting that those respondents who experienced positive peer support as measured by the SIT was consistent with a positive experience of peer support as measured by the more (wind technician) specific items in the WTT. All the correlations were moderate, indicating that the sector specific domains of the WT Tool have commonality with the domains measured by the existing SIT, but were not so closely related as to question their added value.

Table 5 shows how the three additional WT subscales relate to the SIT subscales. As would be expected, correlations between the new WT domains and the SIT scales were generally lower than those in Table 4, which showed relationships between 'paired' SIT and WT domains. However, the correlations between the three new WT domains and the seven SIT domains were all moderate (between r=0.5 and 0.7) and highly significant (p<0.001), so we can be highly confident that these new domains are related to the established SIT domains and are all aspects of a broad stress risk construct. Of further interest is the pattern of relationships between the SIT domains and the new WT domains: *SIT Change* and *SIT Management Support* were found to be of the three most strongly correlated domains to all three of the new WT domains, with *Wellbeing Culture* being slightly more strongly related to SIT Peer Support and *Fatigue* and *Safety Culture* being more strongly related to *SIT Demands*.

Table 5: Additional Subscales - Three highest correlations with the SIT (r)

WT Fatigue culture	SIT Change ** 0.68	SIT Manag't Support ** 0.66	SIT Demands ** 0.67
WT Safety culture	SIT Change ** 0.66	SIT Manag't Support ** 0.65	SIT Demands ** 0.65
WT Wellbeing culture	SIT Change ** 0.64	SIT Manag't Support ** 0.68	SIT Peer Support ** 0.61

**All correlations above are statistically significant at the 0.01 level.

Wider Construct Validity - WT and mental health outcomes

The relationship between mental health and the wind technician domains provides additional support for the value of this sector specific tool. The SIT and WT tools are both positively phrased, with high scores indicating a healthy workplace and low risk of stress (although some items require reversal). These domains would be expected to negatively correlate with scores on the PHQ-4, which is a measure of mental health difficulties using negatively phrased items which produce an overall score for mental health (Anxiety and Depression).

Consistent with expectation, highly significant ($p<0.01$) negative correlations were found between all WT domains and overall scores on the PHQ-4. This means that organisations scoring highly (low stress risks) on WT domains are less likely to have employees suffering from severe mental health problems. The strongest relationships were found between PHQ-4 and WT Wellbeing culture (r= -.63), followed by WT Work Intensity (r= -.56) and WT Fatigue culture (r= -.50). These data also provide further support for the value of the new WT domains, as two of the three new factors are of the those most closely related to mental health.

Content Validity

Content validity refers to the extent to which the items on a questionnaire are fairly and fully representative of the entire domain the questionnaire seeks to measure. In this case, the domain of interest was stress risks for people working as technicians in the offshore and onshore wind sectors. The content was established by a qualitative study gathering perspectives and experiences from 27 wind technicians sampled from a diverse range of onshore and offshore companies. Having completed the EFA and confirmed the reliability and construct validity of the domains, the subscale structure was then reviewed against the initial qualitative themes, to ensure the WT tool was representative of the concerns expressed by technician workers in the qualitative phase of the investigation.

WT Benchmark data

Benchmarks offer important information to support the interpretation of your data. They provide a standard or point of reference against which you can compare your scores with scores in other companies. The benchmarking data provided below allows you to compare your mean scores with the responses of between 120 and 166 wind technicians. It is important to be aware that these data have been generated from a small sample and comparisons should be undertaken with caution. Nonetheless, the benchmarks presented here represent the best data currently available. Mean scores (50th), 25th and 75th percentile scores are provided below.

• **Above the 75th percentile** – This suggests that your technicians' perceptions of their stress risks in this domain are more favourable than 75% of the respondents in the development sample. However, further exploration of items within the domain may reveal pockets of higher risk.

• **Between 75th and 25th percentile** - This suggests that your technicians' perceptions of their risks in this domain are aligned with the middle 50% of respondents in the development sample. Whilst a score in this band is aligned with the majority, there is room for improvement to provide a healthy working environment. Further exploration of items within the domain may reveal areas of particularly high or low risk.

• **Below 25th percentile** – This suggests that your technicians' perception of their risks in this domain are more negative than 75% of respondents in the development sample. This indicates a higher level of risk to employee health and wellbeing, and we recommend that this is a priority area for further consideration.

	WT Demands Work intensity	WT Demands Work enviro't	WT Control	WT Peer Support	WT Manager Support	WT Role	WT Relat-ionships	WT Change	WT Fatigue Culture	WT Safety Culture	WT Wellbeing Culture
Mean	3.08	3.67	3.67	3.80	3.67	3.00	3.33	3.00	3.40	3.50	3.33
75th percentile	3.67	4.00	4.00	4.20	4.00	3.67	4.00	3.60	3.80	4.00	4.00
25th percentile	2.33	3.00	3.00	3.23	3.00	2.33	2.67	2.40	2.50	3.00	2.67

Final note – request for support with ongoing development

This document evidences that the WT tool has been developed with a statistical evidence-base in response to rapid changes in working practices. It provides a useful mechanism for wind companies to explore emerging challenges relating to field technician working conditions and characteristics. Development for this instrument is ongoing and will include further validation and more comprehensive benchmarking. Users of this tool are encouraged to share their anonymised data with the research team to support this ongoing development. If you are willing to share your data, or would like to discuss further support, please contact Prof. Fiona Earle, at the University of Hull humanfactors@hull.ac.uk.